Vol. III

TRANSCRIPT OF RECORD

(Pages 639 to 1197)

Supreme Court of the United States

OCTOBER TERM, 1944

No. 189

THE CONNECTICUT LIGHT AND POWER COMPANY, PETITIONER,

vs.

FEDERAL POWER COMMISSION

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA

PETITION FOR CERTIORARI FILED JUNE 23, 1944.

CERTIORARI GRANTED OCTOBER 9, 1944.

APPENDIX TO BRIEF FOR PETITIONER.

VOLUME III, pages 639 to 1161.

IN THE

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA.

No. 8341.

THE CONNECTICUT LIGHT AND POWER COMPANY,
Petitioner,

v.

FEDERAL POWER COMMISSION,
Respondent.

ON PETITION TO REVIEW ORDER OF FEDERAL POWER COMMISSION ENTERED MAY 15, 1942.

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* * * * * * * [*2011*]

CALVIN T. HUGHES,

a witness called on behalf of the Federal Power Commission, being first duly sworn, testified as follows:

Direct Examination by Mr. WAHRENBROCK.

Q Will you please state your name, Mr. Hughes, and your address, for the record? *A* My name is Calvin T. Hughes. My home address is Milldale, Connecticut. My business address is 250 Freight Street, Waterbury.

Q What positions have you held with The Connecticut Light and Power Company, and what were the duties of those positions? *A* Cadet engineer, which consisted of making small studies of different parts of company property. Assistant engineer, which was the next step above, with a little more responsibility; duties involved layouts of substations, maybe some distribution lines, some transmission work, and the usual routine duties that go with operating. I was for a while, [*2012*] had title of designing engineer, which was along about the same lines, with maybe a little more specific responsibility for laying out of different projects, jobs, lines, substations, or what have you. Then I was electrical engineer with the company, which broadened my duties somewhat, to include more complicated problems, and problems of a more general nature affecting the operations of the whole company. Then I was a general engineer, which position involves responsibility for certain lines of work. As used in our company, a general engineer is capable of carrying out a whole large project, including its design and the supervision of its construction and placing in operation, and looking after its operation after it is put in service.

And at present I am general superintendent, in which job I am responsible for the operating, construction and maintenance matters throughout the property, with particular reference to the

plant, physical facilities, means and methods for getting work done, and all that nature of thing.

Q Does that complete your statement of the positions you have held and the duties of those positions? *A* In the company, yes.

Q How long have you been general superintendent? *A* Since March, 1939, or thereabouts.

Q And how long have you been with the company and its predecessors in all? [*2013*] *A* Since December 18—or December 19, 1918.

Mr. Wahrenbrock: I show respondent's counsel the power system statement for the year ending December 31, 1937, made by The Connecticut Light and Power Company, covering its main system, filed August 4, 1938, I believe, and direct respondent's counsel's attention to the map which is a part of that power system statement, as a preliminary to showing it to the witness.

(Document handed to Mr. Branch.)

Mr. Branch: All right.

By Mr. Wahrenbrock: *Q* Directing your attention to the map which is a part of that 1937 power system statement, I will ask you if the description of the Montville to Groton Long Point line on that map is accurate as of the date of that map, which is, I believe, March 1, 1938. I refer to the legends and the columns at the left-hand side of the page. *A* I believe it is.

Q Where was the Borough of Groton load usually carried? What generating plant usually carried it? *A* Montville usually carried it.

[*2014*] *Q* What is the capacity of the Montville plant? *A* It is 55,000 kilowatts.

Q 55,000? *A* Kilowatts.

Q What is the largest sized unit in the plant? *A* Well, the largest unit is a steam turbo-generator which has, I believe, a nominal rating of 25,000 kilowatts, but can produce somewhat in excess of that.

Q The name plate rating is 25,000 k. w.? *A* I believe it is.

Q Directing your attention to that map in that same power system statement again, I will ask you if the description in that map of the Borough of Groton substation is properly set forth? *A* The print is so fine my glasses don't quite pick it up. (Witness examines document.) Well, it is indicated here as a transmissic . substation. I didn't prepare this map and your question is, "Was it correctly shown on here?"

Q As of the date of the map. *A* Well, I think it could be either considered correctly or not correctly. It could be classified as a distribution substation, I think, logically, if that was desired. It is classified here as a transmission substation.

Q And you wouldn't say that was incorrect? *A* Well, that is just a question of opinion.

[*2015*] Mr. Wahrenbrock: You have furnished me these three photostats of a memorandum from Mr. Perkins to Mr. Knowlton, Mr. Branch dated June 21, 1935. I only took three copies from you and left the remaining ones with you.

I hand the reporter a photostat of an office memorandum from R. W. Perkins, vice president, to R. H. Knowlton, vice president, dated June 21, 1935, and a similar copy to the Examiner, these documents being copies furnished me by respondent's counsel in response to my questions, being copies of data produced in response to the subpoena duces tecum.

The memorandum has attached to it a rough sketch.

I ask that that memorandum and attached sketch be identified as Exhibit No. 66 for Identification.

Trial Examiner: It will be marked Exhibit No. 66 for Identification.

(Document referred to was marked Exhibit Number 66 for Identification.)

By Mr. Wahrenbrock: *Q* Mr. Hughes, I show you Exhibit 66 for Identification—

Mr. Branch: May I see it? I don't seem to have a copy of the whole thing.

Q I direct your attention, Mr. Hughes, to the first paragraph of that memorandum, which reads as follows:

> "To make our deliveries to the Borough of Groton absolutely clear under the terms of the contract, I think I will have to [*2016*] refer you to the attached very rough sketch and then call your attention to the wording in paragraph 3 on page 2 of our contract with the Borough, emphasizing the words 'At the above mentioned substation of the Power Company at Trails Corner, in the town of Groton; the end of its existing 33,000 volt transmission lines at Groton-Long Point, and such other points as may be mutually agreed upon.' "

I stop quoting from the memorandum and ask you, Mr. Hughes, if at the date of this memorandum, June 21, 1935, the 33,000 volt line to Groton-Long Point was commonly referred to by the officers and employees of the Company as a transmission line. *A* It was.

[*2017*] *Q* Now, I refer you to the third paragraph of the same memorandum, the second sentence of which reads as follows:

> "At the Groton Long Point substation the voltage is transformed to 6600 volts, and from this point a single circuit to the extreme south end of the Groton Long Point and the cable delivers the energy to Fishers Island at 6600 volts,"

and I end my quotation at that point and ask you whether it was commonly known to the officers of The Connecticut Light and Power Company that the electric energy which it sold to the Borough of Groton was delivered to Fishers Island?

Mr. Branch: May it please the Examiner, I don't think that is an issue. I stated that the first time that that question came up, that we did know of it, and made no contention that we didn't. I don't see the point of examining witnesses on that.

* * * * * * [*2018*]

Mr. Branch: By "the electric energy", do you mean some of it or what?

Mr. Wahrenbrock: I will reframe the question in accordance with that suggestion.

By Mr. Wahrenbrock: *Q* That some of the electric energy which The Connecticut Light and Power Company delivered to the Borough of Groton was delivered to Fishers Island at 6600 volts? *A* Yes.

Q I wish now to call your attention again to that map which is attached to the 1937 power system statement to which I referred a moment ago, and which is before you there, and [*2019*] call your attention to the facilities at Bristol, as shown on that map and ask you if they are properly indicated on the map, and by the legend to the map.

Mr. Branch: I think it should appear for what purpose they are indicated. A great point has been made by the Commission that the purpose makes all the difference, and it doesn't seem to me that what appears on this map necessarily has any bearing on the issues here.

Trial Examiner: I think the witness may explain the purpose at the same time. I believe that would take care of the matter.

* * * * * *

The Witness: The facilities at Bristol here are indicated as a substation, and in the legend Bristol is indicated as a transmission substation. That is due, I think, to this fact, because I noticed all substations on this map, or the few that I happened to notice—I didn't remember the map in particular—that are connected either to 66,000 volts or [*2020*] to 33,000 volts, are accounted for here as being transmission. That has been used in some departments —the map making department in the company, I know, has so considered those things at times, whereas others in the company would consider that Bristol was not a transmission substation, that it merely hooks up with the voltage of the line that supplies it. It does not definitely, to my mind, classify as to whether the substation would be a transmission substation or a distribution station. I notice several substations here in the tabulation that are in the

tabulation as transmission substations. That, outside of the fact that they have 66,000 volts, is the only meaning that they have, that they are connected to a source of 66,000 volts, because obviously some of them are in error.

[*2021*] *Q* Would you say that that map which was submitted with that power system statement was in error with respect to the designation of the Bristol substation? *A* I would.

Q You say it is in error? *A* Yes.

Q As of the time it was made and submitted? *A* I think so.

* * * * * *

Mr. Wahrenbrock: I hand the reporter for identification as Exhibit 67, a photostat of a copy of a letter signed by C. T. Hughes, addressed to Mr. W. C. Allen, Division Plant Superintendent, Western Union Telegraph Company, 60 Hudson Street, New York City, under date of May 16th, 1939, this being a photostatic copy of the letter furnished me by respondent's counsel pursuant to my request after examination of the data they have made available to me, pursuant to the requirements of the subpoena.

May the copy I have handed the reporter be marked for [*2022*] identification?

Trial Examiner: It will be marked by the reporter as Exhibit No. 67 for Identification.

(Document referred to was marked Exhibit Number 67 for Identification.)

By Mr. Wahrenbrock. *Q* I show you Exhibit 67 for Identification and ask whether you signed the original of which this is a copy? *A* I believe I did. I recognize it, anyway.

Q Do you recall that on the same day you wrote two other letters, substantially identical with this letter, one to the Telephone Company, I believe it is New England Telephone Company, and one to the New Haven Railroad? *A* That is quite likely. These things go to a great many each time, and it is quite logical that I should

Mr. Wahrenbrock: I might say that I have seen such letters. I don't care to clutter up the record with more than one of them, as long as one illustrates my point.

By Mr. Wahrenbrock: *Q* I direct your attention to the first paragraph of that letter, which reads:

> "The Connecticut Light and Power Company is constructing a 22,000 volt transmission line from its existing substation at Columbia, to its existing substation at Colchester. Your facilities will be crossed at one point as shown on the photo- [*2023*] static copy of the map attached."

I ask you whether it was common among the officials of the company to refer to the line there referred to as a transmission line.

Mr. Branch: I object unless the purpose to which they referred is shown.

Mr. Wahrenbrock: I will ask it this way:

By Mr. Wahrenbrock: *Q* —Whether it was common among the officials of the Company to refer to this line for any purpose or for all purposes as "transmission lines"?

Mr. Branch: Same objection.

Trial Examiner: I think under the circumstances, if it is not for all purposes, the witness can show what the purposes are. The objection is overruled.

A In this question of lines, as to whether they are transmission or distribution or supply lines, there is not a clear-cut line of demarcation as to what is what.

Mr. Wahrenbrock: Mr. Examiner, I wish to ask that that part of the answer which has been given be stricken and that the witness be requested to answer the question directly.

Mr. Branch: I think he may be allowed to proceed until he has finished, and let us see whether he has answered it.

Trial Examiner: I think the witness's method of answering the question may be permitted. The motion to strike is over- [*2024*] ruled.

Mr. Branch: May he not be permitted to go on with his answer?

Trial Examiner: You may proceed with your answer. Will the reporter read back the statement that has been already made?

(Statement read.)

A As to which is transmission and which distribution and which supply lines, as the terminology is ordinarily used in our company, in the general organization, I know occasions that we think of and so treat 22,000 volt lines as being transmission, that is, when you speak of it, use it in a certain sense. But, if I was considering it from a different point of view, I would call it a supply line, if I would give the matter any thought.

In dealing with the communication people, anything carrying on negotiations with the Telephone or the Telegraph or outside companies, most joint-line practice only goes up to 5,000 volts and the Telephone Company are inclined to call anything above 5,000 volts, transmission, not that it is in the sense of a transmission line, but that is just common terminology between them, among them, in our usual discussions, there being no clear-cut distinction as to whether it is. If I were discussing this with our people I would be inclined to call it a supply line, neither a distribution nor a transmission, I would say it was a supply line. That is our ordinary day-to-day use of the [*2025*] term.

By Mr. Wahrenbrock: *Q* Does that complete your answer? *A* Yes.

[*2026*] *Q* What was the purpose for which that line referred to in Exhibit 67 for Identification was being constructed? *A* It was being constructed to supply the loads in East Hampton, Leesville, and that general territory.

Q How had those loads previously been supplied? *A* Power had been purchased from The Connecticut Power Company in Portland.

Q And a line owned by the company had run from Pole 110 of The Connecticut Power Company in Portland to the facilities of

The Connecticut Light and Power Company in East Hampton? *A* Yes.

Q That line from Pole 110 to The Connecticut Light and Power Company's facilities in East Hampton was abandoned or removed, was it, subsequent to July 1, 1939? *A* Yes.

Q And this line referred to in Exhibit 67 for Identification was to serve the purpose which had formerly been served by that line from Pole 110 to East Hampton? *A* That purpose plus a little additional more.

Q What was that? *A* We increased the voltage on the lines from 13,800 to 22,000, with new construction. That decreased the drops and losses, and so forth, and it eliminated the purchase of power which we found it was more economical to supply from our own facilities.

[*2027*] *Q* Now, aside from such increase in lines and transformer losses as might have been due to the use of the higher voltage, there wasn't any sudden increase in the loads of East Hampton, Leesville and Colchester districts overnight, prior to July 1st, was there? *A* I will have to make that a little clearer, just why that was done. It isn't a yes or no answer. I can tell you the story of why it was.

Q I wish you would answer the question to the point as much as you can, but explain it as necessary. *A* Several years previous to this time, it was realized that as the load in this territory grew, it would likely be more economical to supply it from the company's lines. In the hurricane of 1938, in the Fall of 1938, the small Leesville hydro electric plant was incapacitated. It was washed—part of it was washed away. This naturally required such power as the Leesville hydro plant was furnishing to the territory be added to the purchase requirements, and it became evident at that time that it would be profitable for us to supply the load from our own generating facilities, and plans were gotten under way to do it. If I remember correctly, we had hoped to have the construction completed by January 1, 1939, but it was

delayed about six months because of troubles in the hurricane, and our construction crews were busy, and we just didn't get it done.

[*2028*] Mr. Wahrenbrock: Mr. Examiner, at this time I offer Exhibit No. 67 for Identification in evidence.

Mr. Branch: I object on the ground that it is immaterial.

Trial Examiner: The objection is overruled. Exhibit 67 is admitted in evidence. Exception will be noted for the respondent.

(Exhibit 67 for Identification received in evidence as Exhibit 67.)

By Mr. Wahrenbrock: *Q* Mr. Hughes, I now show you Exhibit 43, and call your attention to the paragraph at the bottom of the second page of that exhibit, the paragraph which is numbered IV, and which reads:

"The buyer", and by that the reference is to the Central Connecticut Power and Light Company, and I ask you if the Central Connecticut Power and Light Company was a predecessor of the Connecticut Light and Power Company? *A* I believe that is so.

Q I now continue reading:

"The buyer agrees to install a rotary condenser or other equivalent apparatus of suitable size to control its power factor, and further agrees to maintain during the term of this contract, or accept adjustment of demands thereto, the following power factor on its system at all hours requested by the [*2029*] seller: 60 per cent for demands" *A* I don't follow you.

Trial Examiner: That is Roman numeral IV. It starts at the bottom of the second page.

By Mr. Wahrenbrock: *Q* Do you find the place now, Mr. Hughes? *A* Yes.

Q I continue reading: "80 per cent for demands less than 500 kilowatts; 90 per cent for demands of 500/2000 k.w.; and 95 per cent for demands over 2,000 k.w." That is the end of the quotation, and I ask you, Mr. Hughes, whether the rotary condenser, or other equivalent apparatus, was maintained, if it was main-

tained, pursuant to the requirements of this term of the contract? *A* I believe there was a condenser, a static condenser installed at the East Hampton substation. Just when it was installed, I don't know, and I am not sure about the capacity. But there was a static condenser there, I am sure.

Q Up to what date, approximately?

* * * * * *

A It was up to the time the old East Hampton substation was dismantled, which was shortly after July 30, 1939. That substation was dismantled, and the condenser was taken [*2030*] out. But there was another contract that superseded this arrangement in 1936.

* * * * * *

Q Was that static condenser a rotary condenser? *A* No.

Q A synchronous condenser? *A* No.

Trial Examiner: Will you answer? I don't think the reporter can take a shake of the head.

The Witness: I said no.

By Mr. Wahrenbrock: *Q* Did that condenser in general serve the same purpose which a synchronous condenser would have served? *A* In broad terms, yes. There is some—technically there is some difference, but in broad terms, yes.

* * * * * * [*2031*]

Mr. Wahrenbrock: I hand respondent's counsel, the Examiner and the reporter, for identification as Exhibit No. 68, photostatic copies of the map which is part of the Power System Statement for 1937, to which the previous questions and answers referred, and ask that it be identified and admitted in evidence.

Mr. Branch: I object to its admission on the ground that it is immaterial in purpose, characterization not appearing, the witness having stated that these terms were loosely used.

Trial Examiner: Does counsel contend that this may not be deemed admissible for any purpose?

Mr. Branch: I didn't understand you.

Trial Examiner: I say, does counsel contend that nothing contained in this map be deemed material?

Mr. Branch: Well, if it is designed to show the facilities of the Company, I would say that it does not appear to show the connections with the C. P. lines or anything of that kind, and I don't understand that it is offered for any purpose, except a certain character. I have no doubt that it is an accurate map of the State of Connecticut, and in a good many other ways it may be all right, but that isn't what it is offered for.

Trial Examiner: Does counsel have any question as to the [*2032*] accuracy of the name-plate rating statements shown on the various stations?

Mr. Branch: As to what, sir?

Trial Examiner: Name-plate ratings as shown in regard to various stations.

Mr. Branch: I am not quite sure that I understand what you mean by "name-plate ratings", sir.

Trial Examiner: Well, now, for instance, Leesville is marked here with the figures 390 under it, and the legend down on the lower right-hand corner shows—

Mr. Branch: I just don't know, sir, because I have never examined it, but I didn't understand that was the purpose of offering it. There is a great deal of detail on that map.

Trial Examiner: I don't know that there was any general purpose expressed. I think a couple of questions were asked but counsel didn't state that the purpose was limited to the answers to those questions.

Mr. Branch: Well, I should think the purpose ought to be stated, and the parts of it which are to be considered. Just presenting a map without a statement of the purpose, it seems to me would be a matter that would call for a question as to the purpose for which it is offered.

Trial Examiner: Will Commission counsel state the purpose?

Mr. Wahrenbrock: The purpose of identification?

Trial Examiner: No, the purpose of offering it in evidence. [2033] As I understand, it is offered both for identification and in evidence.

Mr. Wahrenbrock: And the purpose of my offering it in evidence is to show the existence of the several facilities shown thereon owned by The Connecticut Light and Power Company, to show its ownership of those facilities, and particularly facilities which have been the subject of testimony in this proceeding, upon which we assert Commission jurisdiction at the time covered by the map, may be said to rest in part. Also for the evidence it throws upon the mode of characterization of the facilities in question by the Company, in its report to the Federal Power Commission.

Mr. Branch: I think in view of the testimony of this witness, the characterizations are not proper to be put in evidence, and I object to those going in.

Trial Examiner: I think that may affect the degree only, in that matter, Mr. Branch: The objection of the respondent is overruled and the exhibit will be admitted in evidence as Exhibit Number 68. You will note an exception for the respondent.

(Exhibit 68 for Identification was marked Exhibit 68 in Evidence.)

Mr. Wahrenbrock: I hand respondent's counsel, the Examiner and the reporter, for identification as the next exhibit, photostatic copies of the map which is part of the corresponding Power System Statement for the year 1938, and offer it in evidence.

[2034] Trial Examiner: Has counsel any objection?

Mr. Branch: Same objection, sir.

Trial Examiner: The objection will be overruled. The photostat will be admitted in evidence as Exhibit Number 69. Note an exception for the respondent.

(Exhibit Number 69 for Identification was received in evidence.)

Mr. Wahrenbrock: I hand respondent's counsel, the Examiner and the reporter, for identification as the next exhibit, photostatic copies of the corresponding map submitted in the corresponding Power System Statement for the year 1939, and ask that it be marked in evidence.

Mr. Branch: Same objection.

Trial Examiner: The objection will be overruled and the photostat will be admitted as Exhibit Number 70. Note an exception for the respondent.

(Exhibit Number 70 for Identification was marked Exhibit Number 70 in Evidence.)

[*2035*] Mr. Wahrenbrock: I hand respondent's counsel, the Examiner, and the reporter, photostatic copies of map and legend pertaining thereto, from the Electric Power Survey report of the respondent for 1927 to 1933, for identification as the next exhibit, and ask that it be received in evidence.

Mr. Branch: What is the date of this? What is the date when this was filed?

Trial Examiner: Will you state the date of the filing, Mr. Wahrenbrock?

Mr. Wahrenbrock: I can in a moment. It will have to be checked for me.

Mr. Branch: Will you also give me the primary instructions which appeared in this, which were evidently followed in making this out—the general instructions.

Mr. Wahrenbrock: I shall be glad to have those incorporated by reference from the form of the respondent.

Mr. Branch: Well, I should like to see this before taking my position in respect to this.

Mr. Wahrenbrock: I will be glad to show it to you.

Trial Examiner: Will counsel submit the copy of those instructions to respondent's counsel?

Mr. Wahrenbrock: Yes, sir. I hand respondent's counsel the document, report of Electric Power Survey of The Connecticut

Light and Power Company (main system), central territory only, to the Federal Power Commission, and direct his attention [*2036*] to the instructions which appear on the second page thereof, inside the cover.

May the record show that respondent's counsel have returned the report to Commission's counsel.

Mr. Examiner, at this time, in accordance with an understanding with respondent's counsel, I would like to suspend with the examination of Mr. Hughes, temporarily, with the right to recall him later, and call Mr. Colvin.

Trial Examiner: Before doing that, I would like to ask one question in regard to Exhibits 59 and 70. I understood that the objection did not include any question as to the fact that they actually were maps attached to such reports.

Mr. Branch: Oh, if Mr. Wahrenbrock assures me that is so, I am satisfied with his statement.

Mr. Wahrenbrock: They have been prepared from the original maps in the possession of the Federal Power Commission.

Trial Examiner: It is so understood.

Mr. Wahrenbrock: I would like to have a ruling on these that I have offered.

Mr. Branch: I didn't realize that anything had been offered that hadn't been ruled on.

Trial Examiner: Exhibit 71 hasn't been formally offered yet, I don't think.

Mr. Wahrenbrock: I do so offer it.

[*2037*] Mr. Branch: I object on the ground it appears that this was filed in January, 1935, and also that the designation was not the designation that the company itself necessarily adopted.

Trial Examiner: It will be marked for identification. The question of admission will be reserved.

(The document referred to was marked as Exhibit No. 71 for Identification.)

* * * * * *

ALLAN D. COLVIN,
previously sworn, resumed his testimony.

Direct Examination (resumed) by Mr. WAHRENBROCK.

Q Mr. Colvin, will you state your full name for the record, please? *A* Allan D. Colvin.

Q What is your home and your business address? *A* My home address is 8 Nathan Hale Street, New London, Connecticut; business address, 31 Union Street, New London, Connecticut.

Q Will you please state what positions you have held [*2038*] with the Connecticut Power Company, and what the duties of those positions were? *A* I have held one position with The Connecticut Power Company, that of executive vice-president. The duties are of a general supervisory nature, covering at the present time the operations of the six divisions of The Connecticut Power Company.

Q On what days of the month is The Torrington Electric Light Company billed for the electric energy which The Connecticut Power Company sells and delivers to it? *A* My understanding is that the billing covers the calendar month. I do not know on what particular day the bills are forwarded. It is the first few days of the month.

Q Have you any personal familiarity with that billing? Do you see those bills? *A* I see the bills after they have been made out.

Q Are you familiar with the method of billing which is followed? *A* I think I have a memorandum covering the basis of the billing, if that is to what you refer.

Q Yes. *A* The Connecticut Power Company's monthly bill to The Torrington Electric Light Company is based on the following:

A demand charge of $1.75 per kilowatt of maximum yearly demand, less an allowance of 2,500 kilowatts for steam station [*2039*] capacity held in reserve by The Torrington Electric Light Company, an energy charge of 9 mills per kilowatt-hour for the first 160 hours use of the demand and 5 mills per kilowatt-hour for the excess.

A statement of this relationship was filed with the Federal Power Commission by letter from Mr. Barney, General Counsel of The Connecticut Power Company, dated November 8th, 1937. The effective date of this certificate was January 1, 1936.

During the year 1941 there is a credit adjustment of a little over $8,000 being made in nine monthly installments by The Connecticut Power Company.

Q Referring to this 2,500 kilowatt allowance for the steam capacity at Torrington, has there been any change in that allowance recently? *A* No, sir.

* * * * * * [2040]

Q Is the allowance of 2,500 kilowatts based upon the [2041] assumption that The Connecticut Power Company has the first claim on the steam facilities of The Torrington Electric Light Company at Torrington?

Mr. Branch: I object. In the first place, it doesn't seem to me that the matter is relevant at all and in the second place it seems to me it is a matter of contract. The contract should appear.

Trial Examiner: If there is any question of ambiguity in the contract, I think the reasons behind the contract should be explained. The witness will be permitted to answer, and an exception will be noted for the respondent.

A The contract under which Torrington was originally served, was made almost thirty years ago and has been modified by agreement from time to time. The original contract, as I recall it, only called for the delivery of surplus hydro-energy to Torrington. I heard Mr. Barney testify last week that he did not regard the contract as legally binding, I think, upon either party. The reason for maintaining steam capacity at Torrington is mainly if an interruption should occur on the line, supplying Torrington, that a small amount of energy might be available to carry what might be termed the essential loads, such as the hospital, possible street lighting, and things of that sort.

I am not informed in detail about the Torrington plant, but my opinion is that it has an installed capacity in excess [*2042*] of 5,000 kilowatts.

By Mr. Wahrenbrock: *Q* Have you brought with you the original contract of 1912 between The Connecticut Power Company and the Torrington Electric Light Company, together with amendments thereto? *A* I have not.

Q Have you informed yourself as to the dates of amendments thereto? *A* I have not.

Q I show you Exhibit 31 and ask you if that is the statement with respect to the contract between The Connecticut Power Company and The Torrington Electric Light Company to which you referred in your previous testimony as being filed with the Federal Power Commission by Mr. Barney. *A* That, with Mr. Barney's letter of transmission, I believe, is a statement as of November 8th, 1937.

Q And you do not have the actual contract as amended and modified? *A* I have not the copy of it. Some of the modifications may be in writing. I believe that some of them are verbal. That was the reason this certificate was filed with the Federal Power Commission as outlining the existing agreements with Torrington. I understand that a new contract with The Torrington Electric Light Company is under negotiation.

Q At the present time? *A* At the present time.

[*2043*] *Q* Has it come to the attention of The Connecticut Power Company that the steam capacity of The Torrington Electric Light Company is being utilized to serve The Connecticut Light and Power Company from Torrington? *A* The Connecticut Power Company has had no official notice as such. Certain of its officers have knowledge that the steam plant in Torrington is being run. I personally do not understand that the running of that steam plant is limited to the supply of Winsted.

Q Well, will you explain what you mean by that. *A* I understand that certain Torrington street lights are run from that unit.

Q Would the fact of that operation affect the basis upon which The Torrington Electric Light Company is billed by The Connecticut Power Company under the terms of the contract between them, as modified? *A* It has not affected the billing.

Q Are you familiar with the arrangement of the electric light facilities of The Connecticut Power Company at Torrington? *A* In general.

Q Are you familiar with the changes which have been made in those facilities since the beginning of this year? *A* I am familiar with the changes that were made and completed early in March of this year.

[*2044*] *Q* I show you Exhibit 38, and ask you if by referring to that exhibit you can explain the chronological order of the changes which have been made in the facilities by which Torrington is served from CP1 and CP2 from the date as of which this large sheet, which is designated at 4031-F was prepared, down to the present, beginning with the situation as it was as of January 10, 1940, that being the date on this large sheet. *A* Drawing 4031-F, with correction through No. 4, was as of December 31, 1940, and was filed with form 64 of The Connecticut Power Company, and has attached to it a number of stickers, which showed changes that were contemplated in the year 1941, of which the sticker attached to Exhibit 38 is a part. The change that was made at Torrington was the installation of a 15,000—

Q The change made when, please? *A* In the job ending during March, 1931—or '41, excuse me, was the addition of a 15,000 k.v.a. three-phase transformer, connected between the 66,000 volt lines of The Connecticut Power Company and the 2300 volt lines—or buses—that is a correction—of The Torrington Electric Light Company, and that included a modification of the switching on the 66,000 volt side of the Torrington supply, and is located a few hundred feet toward switching tower 276, from the main substation of The Torrington Electric Light Company, which is occupied in part by The Connecticut Power Company.

[2045] *Q* Has there been a change in the ownership of the 2300 volt bus, as between The Connecticut Power Company and any other company? *A* There has not.

Q On the sheet which is marked 4031-F of Exhibit 38, is the 2300 volt bus shown in solid line? *A* It is.

Q And what does that indicate as to ownership? *A* According to the legend, it indicates ownership by the Connecticut Power Company; at the time of your visit in May, 1941, that was drawn to our attention by either you or one of your associates, and we stated that this drawing was prepared for the use of various officers and employees of the Commission and for—

Q You mean of the company? *A* Of the company, and for submission to various regulatory commissions, and we agreed that it was not correct in all its details. And on the sticker which has been attached to this same drawing, the ownership of the 2300 volt bus is indicated as owned by others, the others meaning The Torrington Electric Light Company.

Q Now, have there been any subsequent changes to your knowledge of the wiring of The Connecticut Power Company or the facilities of The Connecticut Power Company at Torrington?

Mr. Branch: I didn't get that question. May I have it [2046] read, please?

Trial Examiner: Read the question back for the benefit of respondent's counsel.

(Whereupon the last question as above recorded, was read by the reporter.)

The Witness: The job was substantially completed early in March, 1941. There remained tag ends of work to do in putting in small wiring, and things on which temporary connections had been made. That continued for a month or two after that, but there had been no essential changes in the installation of apparatus in Torrington since March, 1941, belonging to The Connecticut Power Company.

* * * * * * [2047]

Q Has there been any change in the facilities by which the

facilities of The Connecticut Power Company are connected to the facilities of The Torrington Electric Light Company since this change which you have just described as having been made in March of this year? *A* If I understand the question correctly, the two banks of 7,500 k. v. a. transformers are not normally operated in parallel with the 15,000 k.v.a. bank or the 15,000 three-phase transformer. Either the 15,000 k.v.a. transformer or rather the two 7,500 k. v. a. banks are sufficient for Torrington's requirements, and both sets are not normally in operation at the same time, and both sets have alternated since early in March, 1941.

Q And how is that accomplished, by switches? *A* By switches.

Q Does that require any difference in the wiring connections? *A* No, sir.

[*2048*] *Q* Then, have the facilities by which The Connecticut Power Company's facilities are interconnected with those of The Torrington Electric Light Company remained the same since the completion of those changes in March to which you referred? *A* We have supplied The Torrington Electric Light Company with energy since March, 1941, over the facilities indicated on the tab attached to Exhibit 38.

Q Well, what is there about my question that you can't answer directly, Mr. Colvin? *A* I frankly thought it was a trick question, and I didn't know what the trick was.

Q Well, I am sure I don't either. I would like to have a direct answer. *A* We have used exactly the same facilities over the same bus bars to supply Torrington since March, 1941 to date.

Q Has The Connecticut Power Company received delivery of electric energy to it from any other company at Torrington, in the last few months?

* * * * * * [*2049*]

The Witness: Other than an accidental interchange, I know of no delivery of current to The Connecticut Power Company at Torrington since 1929.

* * * * * *

Q I read the second paragraph of the letter to which I have referred, being a letter dated December 1, 1932, to The Torrington Electric Light Company, Torrington, Connecticut, attention of Mr. C. E. Smith, treasurer, and signed by A. C. Bristol, manager, as it appears on page 170 of the transcript, as follows:

> [*2050*] "Beginning with November 1, all surplus power supplied to your company will be billed at 5 mills. A meter will be installed at the earliest convenience which will measure any power which we might furnish over and above the Torrington load, and which would find its way into the lines of The Connecticut Power Company."

And I ask you if that meter was installed, for measuring any power which The Connecticut Light and Power Company might furnish The Torrington Electric Light Company, which would find its way into the lines of The Connecticut Power Company. *A* I have no knowledge of such a meter, and no knowledge of such a letter.

Q Since August 26th, 1935, has The Connecticut Power Company, in billing The Torrington Electric Light Company, ever allowed a credit for electric energy which The Connecticut Power Company received from The Torrington Electric Light Company? *A* Not to my knowledge.

Q Well, do you know? *A* The bills have passed over my desk each month. I think as unusual a thing as that would have caught my attention. There is no arrangement whereby The Connecticut Power Company agrees to take any energy from The Torrington Electric Light Company, except in case of an emergency, which would require the [*2051*] use of the steam generating plant.

Q Is there any arrangement whereby The Connecticut Power Company would have the use of the steam capacity of The Torrington Electric Light Company in an emergency? *A* The latest emergency that occurred was a sleet storm early in March, 1940 and The Torrington Electric Light Company were asked to start

and did start the plant. Fortunately, it was possible to repair the transmission lines, so that little use was made of the Torrington steam plant.

[*2052*] *Q* Was some use made? *A* Yes, sir.

Q Energy received by The Connecticut Power Company? *A* No, sir.

Q Then what use was made? *A* Torrington presumably used it to supply its customers.

Q And is that pursuant to the arrangement which results in the allowance of a 2500 kilowatt in your billing practice that you described? *A* The allowance of the 2500 kilowatt as I described as to make it available in case of accident or emergency to carry what might be termed essential loads in Torrington, or some part of them, over the emergency.

Q Referring to Exhibit 38, will you describe the facilities of The Connecticut Power Company for the delivery of electric energy to The Connecticut Light and Power Company at Bristol? *A* The 66,000 volt transmission line from the South Meadow substation to Falls Village is tapped at Tower 474, which is located on what is known as Bristol mountain. From that point a tap line 1.83 miles long runs into the City of Bristol and terminates at the plant of The Connecticut Light and Power Company, which is in about the center of Bristol. At Tower 474 certain switching equipment is installed and maintained by The Connecticut Power Company. It consists of [*2053*] two oil switches, one automatic and one non-automatic, and some disconnecting switches. I believe there is a battery at that location to provide the energy to operate the electrically operated oil switches. The tap line from Tower 474 to the plant of The Connecticut Light and Power Company is a steel tower line, and it carries two circuits, each composed of three No. 2 solid copper conductors, as well as a ground wire, which is not electrically connected to those circuits.

Q Where does The Connecticut Power Company's ownership of those two circuits which run from Tower 474 to Bristol substation of The Connecticut Light and Power Company end?

* * * * * *

The Witness: The Connecticut Power Company's ownership terminates with the conductors attached to the steel structure located in the enclosure of The Connecticut Light and Power Company, although I am told that our operating forces test the insulators that are attached to that structure.

Q Do I understand, then, that The Connecticut Power [*2054*] Company's ownership extends to what I might refer to as the hot end of the insulators which are attached to the steel structure of the substation? *A* It ends with the point where the conductors are attached to the insulators.

Q Does the ownership of The Connecticut Power Company include the leads from the conductors which drop down into the substation? *A* I have just testified that it terminates where they were attached to the insulators.

Q Yes, but what I want to clarify is that there are leads which are wrapped around or attached to those conductors which drop down below the insulators, and I want to clarify the question with respect to the ownership of the leads, where it terminates. *A* We own nothing except the lines that are attached to the strain insulators that go at right angles there—to the steel structure in the Bristol enclosure.

Q Well now, may I have this clear, then. Attached to the conductors which come up to those insulators, about two or three or four feet from the conductors, is a loop or lead which hangs down below and goes to the substations. Those are not owned by The Connecticut Power Company? *A* Those are not the property of The Connecticut Power Company.

[*2055*] *Q* Thank you. Now, how are those switches at Tower 474—one of them you referred to as a non-automatic oil switch, and one as an automatic oil circuit breaker. How is the automatic oil circuit breaker operated? *A* The automatic oil circuit breaker is normally operated by current transformers working through relays, to the mechanism that controls the circuit breakers.

Q Can they be controlled by manual operation? Can that switch be controlled by manual operation? *A* They can.

Q Where is the control to that switch located? *A* There is control for that switch located at Tower 474. There is also control for that oil switch located on the property of The Connecticut Light and Power Company, whose operators act as our agents, and can open or close those switches, and have instructions to do so when certain emergency conditions arise.

Q Are you referring now to the automatic and the non-automatic oil switches, or oil circuit breakers at Tower 474? *A* Yes, sir. May I clear up the automatic and non-automatic?

Q Yes, please. *A* The one that is non-automatic was formerly automatic. Its rating is sufficiently low so that we fear a certain short circuit condition developing, the switch might [*2056*], destroy itself. So rather than have it operated automatically, we are using it as a disconnecting oil switch, and not subject to automatic operation. The one I have described as an automatic oil switch is of a more recent design and is capable of handling any amount of energy that is liable to be concentrated at that point in case of trouble.

Q Now, one of those switches is located on the CP1 and one on the CP2 line? *A* Yes, sir.

Q And what is the purpose of those switches? *A* Referring to the automatic and the non-automatic?

Q The two oil switches? *A* The two oil switches—the purpose is to separate the line from Tower 474 to South Meadow substation, and from Tower 474 to the Falls Village station.

Q The lines CP1 and CP2 to the west of Tower 474 can be separated from those lines to the east of the Tower 474 by those oil switches? *A* Yes, sir.

Q And controls, electrically operated controls of those switches are located in the substation at The Connecticut Light and Power Company at Bristol, are they? *A* There is one point from which they may be controlled, located on the property of The Connecti-

cut Light & Power Company in Bristol. That property, the means of controlling [*2057*] those switches and the cable over which it operated, is the property of The Connecticut Power Company.

Q Are those controls located on the switchboard of The Connecticut Light and Power Company? *A* My understanding is that The Connecticut Power Company owns at least one panel in that switchboard.

Q Is that arrangement covered by written contract between the companies? *A* The contract is already in evidence, and it is not. The operators—

Q I don't understand you. *A* The contract for the supply at Bristol has already been introduced in evidence, and it is not contained in that contract. There are written instructions to the operators of The Connecticut Light and Power Company allowing them to act as agents of The Connecticut Power Company in the operation of the plant from The Connecticut Light and Power Company at Bristol the switches which are the property of The Connecticut Power Company at Tower 474.

Q Have you copies of those written instructions? *A* I haven't a copy with me. The main instruction is that if there is an interruption at Bristol, the operator shall energize Bristol from either CP1 or CP2, whichever one he may find alive. The other operations of the switch at Bristol would be normally in the case of a line we desired for main- [*2058*] tenance work, that the switch might be opened, properly tagged, in accordance with the safety rules of the State, and the routine operations. The simple instruction that I have given you, that in case of any interruption, the operator shall make Bristol alive from either CP1 or CP2, which ever he may find available. And I call your attention that, in the connection to the CP1 and CP2, that the leads to Bristol are—from CP1—are on the Hartford side of the oil non-automatic breaker, and on CP No. 2, on the Falls Village side of the automatic breaker.

Q Who issues those instructions? *A* The instructions were

agreed upon between Mr. Whiting, the manager of our Housatonic division, and the load dispatcher in Hartford, in conjunction with the superintendent of power in Hartford, and were signed by both of those men.

Q Now, when you refer to the load dispatcher in Hartford, the load dispatcher of what company? *A* By designation during normal operation, the load dispatcher of The Hartford Electric Light Company is designated as load dispatcher of The Connecticut Power Company, and acts as an agent of The Connecticut Power Company. This is because of communication facilities. Formerly, the operators at Falls Village were designated as the load dispatchers of The Connecticut Power Company, but were unable in times of trouble to get communications with certain points. It was therefore found [*2059*] by having the dispatchers located at the South Meadow station, designated as load dispatchers for The Connecticut Power Company, that the period of interruptions might be shortened.

[*2060*] *Q* Now, I think you referred also to a superintendent. Of what Company were you referring to? *A* I referred to Mr. Douglas, the Superintendent of Power of The Hartford Electric Light Company.

* * * * * *

Q Then do I understand that the instructions to The Connecticut Light and Power Company's operator at Bristol are instructions which are signed by officers or employees of The Connecticut Power Company? *A* By an officer of The Connecticut Power Company.

Q Who? *A* Mr. Whiting.

Q Signed by Mr. Whiting? *A* Yes, sir.

Q Now, is there any instruction by The Connecticut Light and Power Company to its operator at Bristol to observe those instructions? *A* I do not know.

* * * * * * [*2061*]

Q Can you cite me any other instance in which an employee of

The Connecticut Light and Power Company acts under an instruction from The Connecticut Power Company? *A* Well, I can cite that the operators on duty for The Torrington Electric Light Company act as our agents, with similar instructions. The practical side is that our high-voltage men are located in Thomaston. If it is desired for any reason to delay resumption of services, it is possible for one of our men to go from Thomaston to Bristol or from Thomaston to Torrington. If it is desired to keep interruptions at a minimum, it is wise that the man who may be on duty be authorized to energize his community from either line which is alive.

Q Now, may my question be read and answered?

Trial Examiner: Read the question and answer back for the benefit of Commission counsel.

Mr. Wahrenbrock: I just want the question read and answered then, please.

Trial Examiner: All right, then. You will read the question.

[*2062*] (The question is read by the reporter.)

A Similar operating arrangements are in existence between Stamford Division of The Connecticut Power Company and the adjoining divisions of The Connecticut Light and Power Company, on the interchange agreement at that point.

Trial Examiner: Do I understand you to say The Connecticut Light and Power Company, as to both cases? Did I get that answer right?

The Witness: Between The Connecticut Power Company at Stamford and the adjacent divisions of The Connecticut Light and Power Company, which would be, I think, designated as their Greenwich Division and the transmission line that passes through Stamford and terminates, I think, at Norwalk.

By Mr. Wahrenbrock: *Q* Is there any such arrangement with respect to any other point on the C.P. 1 or C.P. 2 lines? *A* I have just testified that there was a similar arrangement as to Torrington. The Connecticut Light and Power Company have no operator at Torrington.

Q I mean, is there any other such arrangement as to The Connecticut Light and Power Company on C. P. 1 and C. P. 2 lines? *A* There is no other place you could have one.

Q Is there anything in writing with respect to any arrangement between the two companies for the operator at Bristol to follow the instructions assigned by Mr. Whiting? [*2063*] *A* I have already testified that I am not familiar with what orders The Connecticut Light and Power Company may have given to their operators at Bristol.

Q Does The Connecticut Power Company depend upon the Bristol operator to obey the instructions issued over Mr. Whiting's signature, as to that operator, without knowing whether that operator has been instructed by The Connecticut Light and Power Company to observe those instructions?

* * * * * *

A I can only say that the Bristol operator does act in the manner that I have described.

By Mr. Wahrenbrock: *Q* You have no knowledge of whether The Connecticut Light and Power Company has done anything, issued any instructions, to see to it that those instructions are complied with? *A* I feel sure that the man assigned as an operator at Bristol would carry out no routine instructions from an officer of The Connecticut Power Company without the approval of his superiors.

Q Mr. Colvin, are you willing to produce either the original, in order that I may make a copy, or a true copy of those instructions, over Mr. Whiting's signature? [*2064*] *A* I will endeavor to do so.

* * * * * *

Q Can you tell me, Mr. Colvin, when those instructions were issued? *A* I cannot give you the date of the last memorandum. There have been several, but the last memorandum I believe is of certainly several years' standing.

Q I wish now to refer again to Exhibit No. 38, and directing

your attention to the left-hand upper corner of that exhibit I would like to ask you to identify at the Falls Village Generating Station, generators Nos. 1, 2 and 3, respectively, on the exhibit. *A* I am unable to identify them as Nos. 1, 2 and 3. The three generators at Falls Village, I believe, are identical. They are shown on drawing 4031-F as of 3,000 kilowatt capacity. I believe they are of Allis-Chalmers make and are installed in approximately 1913 and are driven by suitable waterwheels.

Q You say you are unable to say which is No. 1 and which No. 2 and which No. 3? *A* I frankly don't know whether the one nearest the door [*2065*] is Number 1 or the one on the upstream side of the station. I do not recall the order in which they are numbered. They are identical.

Q Can you identify at the Falls Village substation which is transformer No. 1 and which is transformer No. 2? *A* No, sir. There are three transformers in each bank.

Q Well, which is transformer bank No. 1 and which is transformer bank No. 2? *A* As far as I know the two transformer banks are identical. I do not know which one bears the designation No. 1 and which the designation No. 2. This is a diagram to which we are referring, and it is not necessary that things that are to the north be to the north and things that are to the south be to the south.

Q What is the efficiency of those transformer banks at full load? *A* The categorical answer is, I do not know. Those transformers were purchased by Stone and Webster in 1913. As far as the records of The Connecticut Power Company show, there is no manufacturer's test for those transformers on file. The specifications on which the Allis-Chalmers Company proposed to furnish those transformers to Stone and Webster, about 1913, specified transformers that would have an efficiency of 98.2 per cent at half load, at full load 98.5 per cent, an iron loss in watts of 18,000 and a copper loss in watts of 19,000.

[*2066*] *Q* That is for each bank, is it? *A* It is for each transformer. There are six single-phase transformers.

Q What you have just stated is true for each of those single-phase transformers? *A* The proposal of the manufacturer was to furnish six transformers that would have a characteristic which I have given.

Q At the Falls Village substation, will you please identify on the diagram what is referred to as the North tie-cable and the South tie-cable? *A* I see no such designation on the diagram.

Q I didn't mean to imply that they were on the diagram. I would like to have you point out on the diagram where those tie-cables are.

* * * * * * [*2068*]

Q I show you Exhibit 25, and I show you Exhibit 43, and ask you if those are the contracts under which The Connecticut Power Company has delivered, supplied The Connecticut Light and Power Company, with electric energy at Bristol since August 26th, 1935?

* * * * * *

The Witness: No, sir.

By Mr. Wahrenbrock: *Q* Are these the contracts under which The Connecticut Power Company has supplied The Connecticut Light and Power Company at Pole 110, in Portland? *A* The agreement of August, 1930 was modified by a letter signed by The Connecticut Power Company and The Connecticut [*2069*] Light and Power Company, after they became possessed of the property of the Central Connecticut Power and Light Company, which continued in effect until Exhibit 25, being the contract of December 16th, 1936, became effective.

[*2070*] *Q* Have you a copy of that letter to which you have referred? *A* May I refer to Mr. Barney? I think Mr. Barney has one.

Q Certainly. *A* I am not sure whether I have one or not, sir.

Q I show you a copy of a letter dated February 23, 1933, addressed to The Connecticut Light and Power Company over the signature of yourself, and ask you if you recognize that as a let-

ter to which you have just referred, which is the copy just handed to me by Mr. Barney? *A* It is, and I gave it to Mr. Barney.

* * * * * * [*2071*]

Mr. Wahrenbrock: Having handed one copy to respondent's counsel, I now ask that this be marked for identification as Exhibit No. 72.

Trial Examiner: The document will be so marked.

(The document referred to was marked as Exhibit No. 72 for Identification.)

Mr. Branch: What is the purpose of this? This isn't offered for evidence, is it?

Mr. Wahrenbrock: I am about to do so now.

I offer Exhibit No. 72 for Identification in evidence and request an opportunity to prepare a copy therefrom for myself.

* * * * * * [*2072*]

(Exhibit 72 for Identification received in evidence as Exhibit 72).

By Mr. Wahrenbrock: *Q* Mr. Colvin, I show you Exhibits 51, 8, 9, and 10, and ask you if those are the contracts under which The Connecticut Power Company had delivered electric energy to The Connecticut Light and Power Company at Bristol since August 26, 1935?

* * * * * *

The Witness: Exhibit 51 is a contract made November 1, 1930, which superseded agreements with the Bristol and Plainville Tramway Company, dated August 9, 1916, and also an agreement of March 24, 1917, an agreement with the Eastern Connecticut Power, dated March 27, 1920, and November—with a question mark on my copy—16, 1922, and stating that those [*2073*] companies had been merged into The Connecticut Light and Power Company, and under this agreement The Connecticut Light and Power Company agreed to purchase energy at Bristol.

Trial Examiner: In connection with the question mark to which you referred, is there a mark written in over the November?

The Witness: I can't see whether—there is something written over it. I think it is "March", and that contract was to run until February 17, 1943.

The contract dated December 16, 1936, superseded the contract, Exhibit 51, which has just been described, and is a copy of a contract between The Connecticut Power Company and The Connecticut Light and Power Company, covering the supply of energy to Bristol, and I believe is a photographic reproduction of a copy of that contract from the files of the Federal Power Commission. That is Exhibit No. 8. The letter of January 2, designated Exhibit 9—

Trial Examiner: State the year, please.

The Witness: January 2, 1940, is a photographic reproduction from the files of the Federal Power Commission, of a modification of the price stated in Exhibit 8.

Exhibit 10, is a letter dated January 4, 1940, and I believe is a photographic reproduction from the files of the Federal Power Commission, referring to the letter of January 2, [2074] signed on behalf of The Connecticut Light and Power Company, and approved and accepted by Mr. Knowlton and on behalf of The Connecticut Power Company, by the witness, which contains one other item, and that is a payment, a payment of $2,000 per month, shown in Article 4 of Exhibit 8, is eliminated.

Q Do those exhibits, 51, 8, 9, and 10, constitute all the agreements under which electric energy was sold or has been sold by The Connecticut Power Company to the Connecticut Light and Power Company at Bristol, since August 26, 1935? *A* As far as I know.

Q And you do have knowledge of that subject do you not? *A* Yes, sir.

Q I direct your attention now, Mr. Colvin, to Exhibit No. 37.

Trial Examiner: Before you proceed with that, I would like to ask the witness one question. I am not sure, a moment ago, whether you referred to the letter of January 2nd as being Exhibit No. 9. Did you?

The Witness: The exhibit has left me now. As I understood, the exhibits were those letters.

* * * * * * [2076]

Q Referring to Exhibit 37, will you explain what that agreement is? *A* Exhibit 37 purports to be a copy of a contract made June 6, 1937, between The Hartford Electric Light Company and The Connecticut Power Company. The purpose of this agreement is that The Connecticut Power Company may be assured of a supply of electric energy for delivery to The Connecticut Light and Power Company at Bristol, in accordance with the contract made December 16, 1936, between The Connecticut Light and Power Company and The Connecticut Power Company. A copy of the contract of December 16, 1936, between The Connecticut Power Company and The Connecticut Light and Power Company [2077] forms the last six pages of the exhibit.

Q Now, prior to June 8, 1937, what provision had The Connecticut Power Company made for firm capacity to enable it to carry the Bristol load? *A* It had made none.

Q. Where did the Connecticut Power Company obtain the energy with which it supplied the Bristol load, or under what arrangements did it obtain that energy? I will frame the question to ask, under what arrangements did it actually obtain the electric energy which it supplied? *A* It obtained it from The Hartford Electric Light Company by verbal arrangement, and my understanding is that the terms were in general accord with that outlined in Exhibit 37, covering the supply subsequent to June 8, 1937.

* * * * * * [2078]

Q Mr. Colvin, in referring to an arrangement, did you mean the Connecticut Valley Power Exchange arrangement? *A* The Connecticut Valley Power Exchange has never been concerned with the supply of power to Bristol.

Q Was there any actual specific agreement between The Connecticut Power Company and The Hartford Electric Light Company, to enable The Connecticut Power Company to supply Bristol prior to June 8th, 1937? *A* I have answered that there was no specific agreement, but the fact is that it was supplied.

* * * * * * [2088]

Q I would like to go on and direct your attention to the facilities of The Connecticut Light and Power Company at Bristol, and ask you who owns the metering equipment by which the energy delivered to The Connecticut Light and Power Company at Bristol is measured? *A* The metering equipment at Bristol through which The Connecticut Power Company makes deliveries to The Connecticut Light and Power Company is owned by The Connecticut Light and Power Company.

Q What does that equipment consist of? *A* It consists of current and potential transformers.

Q I am sorry, I didn't understand. *A* Current and potential transformers, a device for recording the demand and a device for recording the kilowatt-hours.

Q Where are the current transformers to which you refer located? *A* They are on the 66,000 volt circuits.

[2089] *Q* Are they what are commonly referred to as Niagara-type current transformers? *A* I believe so.

Q The potential transformers are separate transformers? *A* I have no recollection of seeing the specific potential transformers which supply that.

Q Where are the meter instruments located? *A* Within the property of The Connecticut Light and Power Company.

Q Inside the substation building at Bristol? *A* Inside the building at Bristol.

Q I notice that you were referring to a document before you answered the question as to the ownership of the metering equipment. Were you referring to the contract for the sale of electric energy between the two companies? *A* I was.

Q And what is the date of that contract? *A* December 16, 1936. The reason I referred to it is that under Article 3 at the top of page 2 of the exhibit, as I have it, is the statement: "Said electric power shall be in the form of three phase, 60 cycle alternating current, and shall be delivered and measured at approximately 66,000 volts, suitable metering equipment furnished and installed by the buyer at the substation of the buyer in the City of Bristol."

[*2090*] *Q* Is that contract to which you are referring Exhibit 8? *A* Exhibit 8 is a photographic reproduction from the files of the Federal Power Commission of a copy of the contract filed with them in Washington, and the paragraph which I read in the answer to the preceding question is the last sentence in Article 3 at the top of page 2 of Exhibit 8.

Q Thank you.

* * * * * * [*2091*]

Mr. Wahrenbrock: During the recess the witness has reminded me of the request which I addressed to him yesterday, with respect to the operating instructions for the Bristol operator.

With the consent of respondent's counsel, I would like to ask Mr. Colvin if he has brought with him those instructions.

The Witness: I have a copy of those instructions.

By Mr. Wahrenbrock: *Q* Is the copy which you have a signed copy? *A* It is.

Q Will you read into the record the instructions which you have? *A* First may I correct my testimony of yesterday's that the copy bore the signature of Mr. Whiting? Former editions of these rules bore Mr. Whiting's signature. When Mr. Menke was promoted to be superintendent of both the lines and the stations, for organization reasons his signature was substituted.

This copy has been obtained from The Connecticut Company's file at Thomaston. It reads:

"The Connecticut Power Company. Operating Rules, Bristol Operators. May 13, 1940.

[2092] "(1) All power off, open Numbers 1 and 2 line switches at Bristol.

"(2) Put load on line first found alive.

"(3) If load is put in either line without orders, do not close the other line switch.

"(4) If private telephone is out of order, use the Connecticut Power Company commercial phone No. 4387.

"(5) All routine high-line switching should be done under orders from the Hartford Dispatcher.

"Note: When power has been off fifteen seconds, the Falls Village switch at 474 will trip automatic."

Then there has been added in pen and ink, "When No. 2 line is dead, open U. V. Bell knife-switch before closing Falls Village switch."

Signed: "D. Douglass" and the signature typewritten, signed "D. H. Menke", and the signature typewritten, and marked "Copy to A. D. Colvin, F. A. Whiting, C. W. Mayott, D. Douglass and D. H. Menke."

Mr Branch: May I see that, please?

Mr. Wahrenbrock: I hand the original to Mr. Branch.

[2093] By Mr. Wahrenbrock: *Q* You don't have another copy of it? *A* No, sir. I was up until 11:30 to get that out. When Mr. Barney arrives we may have a duplicate.

Mr. Branch: Thank you.

By Mr. Wahrenbrock: *Q* Mr. Colvin, I would like to have you now state the companies by whom each of the men whose names appear in those instructions, or on those instructions, by what companies they are employed, and what their positions in those companies are. *A* Mr. Colvin is executive vice-president of The Connecticut Power Company.

Q That is yourself? *A* Yes, sir. Mr. Whiting is manager of the Housatonic division of The Connecticut Power Company.

Mr. Mayott is manager of the Connecticut Valley Power Exchange.

Mr. Douglass is the superintendent of power of The Hartford Electric Light Company. Mr. Menke is the superintendent of both the 66,000 volt system and the Falls Village station of the Connecticut Power Company.

* * * * * * [2094]

Cross Examination by Mr. SMITH.

Q Mr. Colvin, are any of the names appearing on that operator's instruction sheet that you have just read employees or officials of The Connecticut Light and Power Company? *A* No, sir.

Q Now, I understood you to say yesterday that that switch running from The Connecticut Light and Power Company substation to Bristol Mountain, was owned and operated by The Connecticut Power Company. Is that correct? The meter? *A* If I understood your question correctly, you said the switch running from Bristol to Bristol Mountain.

Q The switch and the line operating the switch? *A* The line running to the top of Bristol Mountain is owned and operated by The Connecticut Power Company. The switches located at Tower 474 at the top of Bristol Mountain are owned and operated by The Connecticut Power Company, except at such times as the Bristol operator may act as an agent of The Connecticut Power Company.

Q And those times when he so acts, those are under orders of The Connecticut Power Company, are they? *A* I have just read the memorandum which is headed, "The Connecticut Power Company operating rules, Bristol operators." A copy of this, I am told, is posted in Bristol. [2095] The telephone installed in Bristol, No. 4387, is paid for by The Connecticut Power Company to provide communications, and I assume that those instructions have the approval of the supervisory force of The Connecticut Light and Power Company, and the purpose of them is to expedite service when an interruption may occur at Bristol.

Q Is there any other purpose, directing your attention, if you

will, to your own employees. I will suggest to you the safety of your own employees.

Mr. Wahrenbrock: Mr. Examiner, I think the question is unclear, and that it ought to be clarified for a proper understanding of the question.

Trial Examiner: Well, I don't know that the question was complete. I am not sure that Mr. Smith had completed his question.

Mr. Smith: I will reframe it, Mr. Examiner.

By Mr. Smith: *Q* Mr. Colvin, you stated that the purpose for operation under the rules was the maintenance of service at Bristol. I ask you if there are any other reasons why this switching equipment at Bristol Mountain is operated under orders from The Connecticut Power Company? *A* Under the rules of the Connecticut Public Utility Commission it is necessary to tag out at both ends and ground a high voltage line on which a man is to work. It is therefore [*2096*] necessary that someone tag out the line from the Bristol substation to the Tower 474 if a man is to work on that line. That will probably be done in normal operation in the presence of an employee of The Connecticut Power Company, and in an emergency would probably be done by a person in the employ of the Connecticut Light and Power Company, in response to a telephone request and confirmation that he had carried out the instructions that he had received.

Q Mr. Colvin, I show you a map entitled "Connecticut Minor Civil Divisions", and I show a copy to the Examiner and one to Mr. Wahrenbrock, and ask you what that is. *A* It is a copy of a map which itself was prepared by the Bureau of the Census, and to which has been added certain designations, and a map that was used, I believe, as Exhibit 8 in the case of The Hartford Electric Light Company before the Federal Power Commission.

Q And does this map show the State of Connecticut? *A* It does.

Q And on this map does there appear the C.P. 1 and C.P. 2 lines and the D-3 and C-4 lines of The Connecticut Power Company? *A* May I interpose a correction? It is C-3 and D-4.

Q C-3 and D-4. Thank you.

Mr. Wahrenbrock: Mr. Examiner, I object to this line of questioning, and move that the last answer be stricken on the [*2097*] ground that in the first place it goes beyond cross-examination. In the second place the respondent, if it has a showing it wishes to make chief, it can do so by calling this witness, without doing so on cross-examination. In the third place, it does not appear that this was prepared by the witness, that he had knowledge of how it was prepared, and again, the question was not directed to any particular time.

Mr. Smith: Mr. Examiner, my questions are simply preliminary to offering this for identification, and I think Mr. Colvin must first state what is on the map and who drew it, how it was prepared. I intend to sufficiently identify it.

Trial Examiner: Do you intend to explore his knowledge of the preparation of the map?

Mr. Smith: I do. I think Mr. Wahrenbrock on direct examination went in to all of the facilities shown on this map.

Trial Examiner: Then your purpose is the connection with that portion of the direct examination?

Mr. Smith: Yes.

Trial Examiner: I think it is related to the direct examination. Counsel may proceed. The objection from Commission counsel is overruled.

Mr. Wahrenbrock: How about the matter of the date, Mr. Examiner?

Trial Examiner: That may be established. We can tell more about that later.

[*2098*] By Mr. Smith: *Q* Does this map, Mr. Colvin, purport to show certain facilities of The Connecticut Power Company? *A* It does.

Q As of what date are these facilities depicted on this map? *A* The map bears no date, but I believe that I identified it as Exhibit 8 in the case of The Hartford Electric Light Company before

the Federal Power Commission, and can only identify the date in that way.

Q Do you remember when The Hartford Electric Light Company case was tried?

Mr. Wahrenbrock: Mr. Examiner, I object to that line of inquiry, to establish the date. An exhibit in that case may have represented facilities as of almost any date prior to the date of the hearing. It certainly would not, in itself, fix the date of this exhibit, if it was an exhibit.

Trial Examiner: It seems to me we should have a little more definite record of the date. It may be that you will be able to get this from some of your other witnesses.

By Mr. Smith: *Q* Mr. Colvin, are you able to state, directing your attention to the present time, January, 1941, we will say, whether or not this map is a correct representation of the facilities of The Connecticut Power Company as of that date?

[*2099*] Mr. Wahrenbrock: Mr. Examiner, I object to that question. It is obvious from the map that this does not represent all of the facilities of that Company. There has been no description of what facilities it does represent, if it represents facilities.

Trial Examiner: I think that may be further explained. The objection is overruled for the present. The map has not yet been offered in evidence.

The Witness: May I have the question?

Trial Examiner: The question will be read back for the benefit of the witness.

(Question read.)

Mr. Smith: July, 1941, I meant to say.

Mr. Wahrenbrock: Mr. Examiner, I object to that question, because on the record as already made in this case it appears that there are facilities of the—

Trial Examiner: That has nothing to do with the admissibility of this question, Mr. Wahrenbrock. That may be an objection to the later admission of the map, but it does not affect the admissibility of the question. The witness may answer.

A The facilities indicated on the map are correct, I believe, as of July, 1941. They are not a complete diagram of the facilities of The Connecticut Power Company.

By Mr. Smith: [*2100*] *Q* Who prepared this map, if you know, Mr. Colvin? *A* I don't know the particular draftsman who prepared it. The Connecticut Power Company has a negative of this map in its files, in the files of its engineering department at New London, from which the prints were made.

Q Was this prepared under your direction? *A* I approved it after it had been prepared.

Mr. Smith: I ask that this be marked as Exhibit No. 73 for identification.

Trial Examiner: It will be so marked.

(Document referred to was marked as Exhibit Number 73 for Identification.)

By Mr. Smith: *Q* Mr. Colvin, are the lines of The Connecticut Power Company shown on this map, beginning with the point "H" at the top of the map here, "Suffield" and running south and west to the point "1" at Salsbury? Are these lines correctly represented as they now are and have been since August 25, 1935?

Mr. Wahrenbrock: Mr. Examiner, I object to that question as going beyond the scope of the cross-examination. I obtained from this witness no testimony, asked him no questions with respect to the "H.-A." lines and with respect to the C. P. lines. I asked him only questions incidental to the facilities at Bristol and Falls Village. It certainly is beyond the [*2101*] scope of direct examination.

Mr. Smith: Mr. Examiner, that map simply purports, I believe it has been testified, to show the C. P. lines about which we have had so much testimony in this case, and Mr. Wahrenbrock on direct examination, asked a great many questions about these lines and about the substations located along the lines. I simply want to discover from Mr. Colvin whether or not this map correctly represents these lines and the substations from the passage of the Act

to date. He stated that they do represent them correctly now, and I simply wish to get that back to the passage of the Act.

[*2102*] Trial Examiner: I think counsel may test the general accuracy of the map by questions regarding portions which perhaps are not directly responsive as to those particular questions on the direct examination, other portions of the map being responsive to the direct examination. The objection of Commission's counsel is overruled. You may proceed.

Mr. Smith: Is there a question pending?

Trial Examiner: There is a pending question. Will the reporter read it.

(Whereupon the last question as above recorded, was read by the reporter.)

The Witness: I doubt if I can answer the question as phrased.

Mr. Smith: I will reframe the question.

By Mr. Smith: *Q* You have testified that the depiction of the lines of The Connecticut Power Company on the map are correct as of the present date? *A* Yes, sir.

Q Now, what changes, if any, have there been since August 24, 1935, to date, on these lines which are not shown on the map? *A* In slightly above the center of the map, at the point or near the point where the town of East Hartford joins [*2103*] the town of Glastenbury, you will find the letters "G" and "L", and a short U-shaped connection between two lines which connect with the short dash running vertically on the sheet to a point called "L". I do not recall the date, but that line was not originally owned by The Connecticut Power Company. It is now owned by The Connecticut Power Company.

Q Are there any other changes except that which you have just described? *A* Subject to verification on the dates, in the Town of Portland, there is a triangle, the figure 14 opposite, which is designated at the Collins Hill substation. My impression is that that was not the property of The Connecticut Power Company in 1935, but is now the property of The Connecticut Power Company.

Q Are there any other changes? *A* I do not note any other changes.

Mr. Smith: I offer Exhibit No. 73 for Identification in evidence.

Mr. Wahrenbrock: Mr. Examiner, I object to that as going beyond the scope of proper cross-examination, and as not sufficiently proved in that the witness has not been able to state that it was prepared by him or under his supervision.

Trial Examiner: I think the last point is well taken. The statement of the witness that it was later approved is hardly equivalent to the statement that it was prepared under [*2104*] his direction. Isn't it possible for you in your case to call the draftsman who prepared the map and identify it? It would be a much more proper way of getting it into the record.

Mr. Smith: I believe the only proof to date of the CP lines has been put in by respondent's counsel, a one-line diagram—excuse me, Commission's counsel—a one-line diagram showing the same line, in which there was no offer of proof as to its correctness, and the only proof as to its preparation was that it had been prepared by one of the Commission's engineers.

Now, Mr. Colvin has testified as to this map that it was prepared by one of many draftsmen of The Connecticut Power Company, that he examined it after it was prepared, and approved it, and that it was correct.

Trial Examiner: If the witness can state that his duties consist of the approval engineering data, that may clarify the situation.

By Mr. Smith: *Q* Will you describe what your duties for The Connecticut Power Company are? *A* The duties are largely as described by the title, executive vice-president. They include the general supervision of the six divisions in which The Connecticut Power Company is organized. The director of engineering at The Connecticut Power Company, Mr. Cecil W. Brown, reports to me all [*2105*] estimates for construction of new property, the retirement of old—they pass through my hands. I am generally familiar with the construction work that is going on in the field. I visit the various divisions as often as time permits. I also spend

a great deal of time in connection with questionnaires from various sources, and also have to do with the corporate affairs of the company, such as the signature on stock certificates and things of that sort. I am a director of the company and attend directors' meetings, and at such meetings do present to the directors of the company, things that require their attention, with which I am especially familiar.

Q Now, has this map or a similar map to this ever been used in connection with your directors' meetings? *A* A copy of this map is on file and is carried to each directors' meeting, so that we may tell the directors by showing it to them what we are talking about.

Q And were you responsible for that practice? *A* The request came from one of the other directors that such a map be provided, and this was the map that was used.

Q And did you have it provided? *A* Yes. That is, I asked the secretary to have one in his custody at each directors' meeting.

Q And after it was prepared, did you examine this map? *A* It was a print of a negative we had in the drafting [*2106*] room, and my examination was a limited one such as I have given it this morning.

Mr. Smith: I now renew my offer of Exhibit No. 73 for Identification in evidence.

Mr. Wahrenbrock: I object on the same grounds, and will say that I shall have some further objections to base on further examination of the witness when I may examine him.

Trial Examiner: Pending those suggested questions, the witness has been just a little indefinite as to his willingness to assume full responsibility for the direction and preparation, and I will reserve decision temporarily on its admissibility.

By Mr. Smith: *Q* Mr. Colvin, do you know how I came in possession of the map which is in front of you? *A* Yes, sir.

Q Will you describe how I did? *A* You called on me at my office in New London. I showed you a copy of the map. You asked me if you might have a copy of it, and agreed to pay for same, and I told you that you might.

Q Did you have copies prepared for me? *A* Yes, sir.

Q Directing your attention to Exhibit 73 for Identification, which has been offered as proof, will you describe [*2107*] the facilities of the Connecticut Power Company located in the vicinity of the figure "F-15", which I believe is the South Meadow substation. *A* I assume this is Exhibit 73, sir?

Q Exhibit 73 for Identification, and the Examiner is reserving his decision. *A* At the location indicated by the symbol "F-15", in the town marked Hartford City, under the legend 15 is the South Meadow substation of The Connecticut Power Company at Hartford, and "F" under the same legend states, "To and from The Hartford Electric Light Company", meaning energy going to and from The Hartford Electric Light Company at that point.

If I may limit my description of the facilities existing at location 15 as prior to the end of March, 1941, I would state that The Connecticut Power Company transformer station at South Meadow is a modern outdoor type station, with structural steel supports. It includes the usual apparatus and material found in such a station, including oil circuit breakers, disconnecting switches, instrument transformers, lightning arresters, bus bars, oil piping, oil storage, cooling and filtering equipment, conductors for 11,000 volt circuits, and three sets of 11,00 volt connections to the wall bushings of the South Meadow steam plant of The Hartford Electric Light Company. The high voltage bus is in two sections, the east section serving the circuits connecting with the lines of [*2108*] the Turners Falls Power and Electric Company, and the west section circuits connecting with the lines to Falls Village. There are five large transformers installed in this transformer station. They include one 12,000 k.v.a. transformer, 69,300 to 11,000 volts, General Electric make, serial No. 2,739,120; two 7500 k.v.a. transformers, 69,300 to 11,000 volts, General Electric make, serial numbers 2,297,332 and 2,297,333. There are also two 25,000 k.v.a. auto-transformers, 66,000 to 69,300 volts, General Electric make, serial numbers 4,126,954, and also 4,126,955. The rating specified is for these

transformers when they are operating as self-cooled units. The two auto-transformers are connected in the leads to the east bus supplying the circuits to Agawam. These auto-transformers are necessary to adjust the voltage between the two systems, and particularly to compensate for the voltage loss in transmission, as at certain periods power may be being sent by The Connecticut Power Company to Massachusetts, and at other times power may be received by it from Massachusetts in considerable amounts.

The line voltage must be compensated, and it is done by these transformers. It is possible to connect the two 66,000 volt buses by the use of a proper oil circuit breaker and disconnecting switches. The 11,000 volt side of the transformers mentioned are connected to the 11,000 volt bus structure in the South Meadow steam station of The Hartford Electric Light Company.

* * * * * * [*2111*]

A Prior to the end of March, 1941, connections were made to enable Line D-4 to operate at 110,000 volts. This involved the installation of a General Electric 30,000 k.v.a. [*2112*] self-cooled Form D.J. three-phase 60-cycle transformer with a high-voltage winding with taps from a high of 126,500 volts to a low of 93,500 volts, and a secondary winding of 11,000 volts.

The serial number of this transformer is 6506136. The 11,000-volt side of this transformer is connected to the 11,000-volt bus structure in the South Meadow steam station of The Hartford Electric Light Company.

The change of both lines C-3 and D-4 to 110,000 volts has not been completed, as of this date.

By Mr. Smith: *Q* When you say "bus structure", Mr. Colvin, do you mean bus structure in the substation? *A* The connections are made to the conductors in the bus structure in the steam station. Electrical energy may be received from or delivered to the 11,000-volt bus structure in the South Meadow steam station. Such energy whether received or delivered is measured for billing by meters owned by The Hartford Electric Light Company and connected in the bus structure inside the generating station.

Q Would you describe very generally, Mr. Colvin, the system of The Connecticut Power Company as shown on this map, Exhibit 73?

Mr. Wahrenbrock: Mr. Examiner, I object to that question, unless it is limited to the subject matter which has been covered by the witness's testimony on direct.

[*2113*] By Mr. Smith: *Q* And limit, if you will, in your description, the lines of the Company connected to Hartford, Bristol and Falls Village.

Trial Examiner: The witness may proceed.

A Referring to the exhibit, starting at the top center of the map at the point designated as "H", two lines are indicated as running to the City of Hartford.

* * * * * * [*2115*]

Q Would you kindly describe in general the system of The Connecticut Power Company, as shown on the map which you have in your possession? *A* I have generally described the lines from the Massachusetts State line to the South Meadow substation. Now, starting at the South Meadow substation there are two circuits that nominally are 66,000 volts which run to the hydro-electric plant of The Connecticut Power Company on the Housatonic River at Falls Village in the town of Canaan. These circuits are located on private rights-of-way supported by steel towers. Substation taps are made from these circuits in order to supply the Connecticut Power Company's requirements at Middletown, those of The Connecticut Light and Power Company at Bristol, the requirements of The Connecticut Power Company at Thomaston and those of The Torrington Electric Light Company at Torrington. These circuits finally terminate through transformers on the 6600-volt bus of The Connecticut Power Company at Falls Village. All of the circuits are three-phase [*2116*] 60-cycle circuits.

Mr. Wahrenbrock: May I have the last few sentences of the answer read, please? I missed one of the expressions.

Trial Examiner: Will the reporter read the last two sentences of the witness's answer?

(The record is read.)

By Mr. Smith: *Q* Have you completed your answer, Mr. Colvin? *A* No, sir. From Falls Village there is a nominal 66,000-volt-line connecting with the Central Hudson Gas & Electric Corporation at Poughkeepsie, New York. This is a single circuit line located on the private right-of-way supported by steel towers. The ownership of The Connecticut Power Company in this line ends at the Connecticut-New York State line, and there are no taps off this circuit in the State of Connecticut. This is also a three-phase, 60-cycle circuit.

Q There was shown to you a contract between The Connecticut Power Company and The Hartford Electric Light Company. I think Exhibit 8, which provided for supply of power by the Connecticut Power Company to The Connecticut Light and Power Company. I want to ask you what the source of primary firm power was for that contract. *A* May I see the exhibit?

Mr. Smith: I hand the witness Exhibit 8.

[2117] *A* (Continuing) Your statement was that it was a contract between The Connecticut Power Company and The Hartford Electric Light Company?

By Mr. Smith: *Q* Between The Connecticut Power Company and The Connecticut Light and Power Company. *A* The source of energy contemplated by this contract was firm power, the steam stations of The Hartford Electric Light Company, the hydro plant of The Connecticut Power Company at Falls Village, and any reserve steam capacity that may have been available at Torrington.

Q That wasn't put in writing, was it, until June of 1937, when The Connecticut Power Company entered into a contract with The Hartford Electric Light Company? *A* Through neglect on the part of either Mr. Barney or the witness, no contract guaranteeing a supply of power to the Connecticut Power Company to carry out this contract was made until June of 1937.

Q Was that contract carried out? *A* It was, sir.

Q Was such firm capacity supplied? *A* It was.

Mr. Wahrenbrock: Mr. Examiner, I am going to object to the last question and ask that the answer be stricken, whether it was firm capacity which was supplied or not is a legal con- [*2118*] clusion and depends on the existence of a contracts committing some capacity to a certain use, and the witness's testimony previously given is that there was no such contract. It is a contradiction in terms.

Trial Examiner: Well, I think firm capacity may have an engineering, as well as a legal meaning.

Mr. Wahrenbrock: Well, not as between two different companies, Mr. Examiner. If I may amplify that and say that Company A owns a huge dependable steam electric generator, that doesn't mean that Company B can depend on it unless Company A is under a contractual obligation to B to allow B to depend upon it. It is a question of contract and contract alone under those circumstances.

Mr. Smith: Mr. Examiner, I believe yesterday Mr. Colvin testified there was a verbal understanding. I simply wish to prove that this verbal understanding was backed up by performance and that was in fact done.

Trial Examiner: You may prove it. The contract does not necessarily have to be in writing.

Mr. Wahrenbrock: Mr. Examiner, I cannot let the statement stand that the evidence of this witness shows that there was a contract, verbal or in writing.

Mr. Smith: I said, Mr. Wahrenbrock, that I believe Mr. Colvin testified that there was a verbal understanding.

[*2119*] Trial Examiner: The objection is overruled and the answer may stand without explanation. The last question has been answered and there is no pending question.

By Mr. Smith: *Q* What is the source of the primary firm power for the interconnected system of The Connecticut Power Company? *A* By "interconnected system of The Connecticut Power Company" we include only the lines from South Meadow substation to Falls Village. The source of power for that line for

firm capacity on that line is covered by contracts, two contracts with The Hartford Electric Light Company, covering their steam generating plant in Hartford, by the hydro-capacity available at Falls Village and whatever reserve capacity may be available at Torrington.

Q Yesterday, Mr. Colvin, you testified in response to questions of Commission's counsel as to facilities at Torrington that except for accidental interchange of energy to your knowledge no energy had gone from Torrington to the C.P. line at Torrington since 1929. Do you remember that? *A* Substantially.

Q Do you know of any such accidental interchange of energy? *A* I do not, and there is no way that I could know it. The meter used by The Connecticut Power Company to supply the Torrington Electric Light Company has, according to the recollec- [*2120*] tion of employees of The Connecticut Power Company, been equipped with a ratchet for at least ten years, which means that it could only register the same as your watch. You turn it one way to wind the spring and do not wind the spring when you turn it the other way.

[*2121*] *Q* So to your knowledge, there has been no power which has gone from Torrington to the CP line at Torrington? *A* There has not.

Q Since 1929? *A* That is correct.

Q Can you, with reference to Exhibit 38, which I believe is your system diagram, describe in general terms the connections of The Connecticut Power Company at Torrington with The Connecticut Light and Power Company? *A* I am describing the connections at Torrington as of the present time.

Approximately two and a quarter miles from the Torrington station of The Torrington Electric Light Company, there is a junction point on The Connecticut Power Company's 66,000 volt transmission line, marked on this exhibit as switching tower 276. At this point there are certain disconnecting switches, and two circuits go to the property of The Torrington Electric Light Company, at which point there are three automatic oil switches, and

there are also installed two banks, each consisting of three 2500 k.v.a. transformers, and one 15,000 k.v.a. three-phase transformers which are nominally 66,000 volts on the high voltage side, and 2300 volts on the low tension side, and feed into the 2300 volt bus of The Torrington Electric Light Company. There is also installed at Torrington a 4,000 k.v.a. [*2122*] rotary condenser on the 2300 volt bus that is the property of The Connecticut Power Company.

There is installed at Torrington the usual lightning arresters, and also meters for measurement of energy delivered to Torrington.

Q What happeens to the— I withdraw that. At what voltage do you deliver at Torrington? *A* At nominally 2300 volts.

Q Do you know of what voltage The Torrington Electric Light Company distributes to its customers? *A* Only generally that it has in general a 2300 volt distribution system.

Mr. Wahrenbrock: I object to the answer and move that it be stricken as not responsive. The question was at what voltage does the Torrington Electric Light Company deliver to its customers.

Trial Examiner: I think he made a statement generally that they delivered 2300 volts.

Mr. Wahrenbrock: I think the witness will understand that is not responsive to the question.

Trial Examiner: But if it is a fact, it is in response to the question. It seems to me the answer is perfectly clear. If the witness is in error, that is another matter.

The Witness: May I have the question?

Trial Examiner: Read the question back for the witness.

[*2123*] (Whereupon the last question as above recorded, was read by the reporter.)

The Witness: I understand the question to mean at what voltage it distributed electric energy to reach its customers, and did not intend to describe the apparatus used on the distribution system of The Torrington Electric Light Company.

Mr. Wahrenbrock: With that explanation, I renew my motion that the answer be stricken, Mr. Examiner.

Trial Examiner: Well, I don't think on the face of it the answer necessarily deserves to be stricken. The distribution may be to industrial customers. I understood him to say it was distributed at 2300 volts.

Mr. Wahrenbrock: That isn't my understanding of the answer.

Trial Examiner: Read back the answer.

(Whereupon the last answer as above recorded, was read by the reporter.)

Trial Examiner: If there is anything further Commission's counsel may bring it out on redirect.

By Mr. Smith: *Q* Mr. Colvin, you testified yesterday that all the changes on Exhibit No. 38, and wiring connections between The Connecticut Power Company and The Torrington Electric Light Company are shown on that diagram. I wanted to ask you if you know of your own knowledge of any changes The Torrington [*2124*] Electric Light Company might have made with any other company?

Mr. Wahrenbrock: Mr. Examiner, I object to that as hypothetical.

Trial Examiner: On what ground?

Mr. Wahrenbrock: On the ground it is a hypothetical question not shown to be based on any facts in the record. What The Torrington Electric Light Company might have done under what circumstances doesn't appear, and the basis of this witness's knowledge is not shown.

Trial Examiner: He is asking him as to whether he has any knowledge. It seems to me that is a preliminary question. He hasn't asked what the changes were. He has a right to know whether he does have knowledge.

The witness may proceed.

The Witness: I testified yesterday that The Connecticut Power Company had no official notice of the changes in Torrington, that certain of its officers had informal information that the Torring-

ton steam plant was being operated, and I testified that it was my understanding that it was being operated not only in connection with what may be the Winsted load of The Connecticut Light and Power Company, but that I was also informed that it involved certain street lighting facilities of The Torrington Electric Light Company. I have verified the question of street lighting facilities since I answered the question, and I have been assured that that is [*2125*] so.

By Mr. Smith: *Q.* Do you know of your own knowledge whether these changes in operation by The Torrington Electric Light Company call for any changes in wiring connections between The Torrington Electric Light Company and The Connecticut Light and Power Company? *A* If the steam plant at Torrington was to serve only a portion of the load, certain changes would have been necessary on the 2300 volt buses or connections of The Torrington Electric Light Company.

Q You don't purport to show those changes on Exhibit No. 38, do you? *A* Why, no, sir. We do not even show the generating plant of The Torrington Electric Light Company.

Q Mr. Colvin, you were asked certain questions concerning Bristol, point of delivery and point of metering.

Trial Examiner: Before you start on a new point of investigation, we will now take a ten-minute recess.

(At this point a short recess was taken, after which the hearing was resumed.)

Trial Examiner: The hearing will now be in order.

By Mr. Smith: *Q* Mr. Colvin, directing your attention to the supply by The Connecticut Power Company at Bristol, I show you Exhibit 8, [*2126*] and ask you if that is the contract, together with Exhibits 9 and 10, two-extension letters, under which the company is now supplying The Connecticut Power Company at Bristol, and has been since January 1, 1937.

Mr. Wahrenbrock: Mr. Examiner, I object to that. It is merely repetitive of what has been clearly brought out several times already. I can see no need of further proving that. I take it there

is no intention of impeaching the witness's testimony on that. It seems to me it is just delaying the progress of the case to go into that again.

Trial Examiner: I think it is repetition. It may be to lay the ground for a further question, and of course, counsel has the right to cross-examine the witness as to his statements made on direct examination.

However, I don't believe that those exhibits as stated have been anything but marked for identification. At least if they are, it doesn't show it in the transcript.

Mr. Wahrenbrock: All those exhibits have been received in evidence, Mr. Examiner.

Trial Examiner: Will you state the date on which 8, 9 and 10 were received in evidence? I was looking through the transcript and couldn't find it.

Mr. Wahrenbrock: The afternoon session of the 15th.

[*2127*] Trial Examiner: Do you have a copy of the transcript of the 15th there?

Mr. Wahrenbrock: Yes, I am sure I do. I hand you the afternoon session which has a list of exhibits and it is not included in the list as there stated.

Trial Examiner: Will you state what page the exhibit was received on?

Mr. Wahrenbrock: Well, that will require a search.

Trial Examiner: If you will do that between now and when we come back this afternoon, because I would like to have that correction made in the record, and also in regard to Exhibit 37.

You may proceed.

By Mr. Smith: *Q* The answer is—? *A* May I have the question? Exhibit 8 handed me is a photographic reproduction apparently from the files of the Federal Power Commission of the contract between The Connecticut Power Company and The Connecticut Light and Power Company, dated December 16th, 1936, covering the supply of energy to Bristol.

Q Directing your attention to Article 4 of this contract, will you state how the charge for energy sold by The Connecticut Power Company to The Connecticut Light and Power Company was determined? *A* Article 4 states that the price to be paid by the buyer shall consist of a demand charge of $1.50 per kilowatt [*2128*] per month of demand, and an energy charge of 4 mills per kilowatt-hour, plus the sum of $2,000. The items of 4 mills and $2,000 are covered by the exhibits or the modifying letters which follow. It then states that the energy charge is based on the cost to the seller, that is, The Connecticut Power Company, of fuel, meeting certain specifications, and then, "and costing $5.30 per net ton delivered in the bunkers of The Hartford Electric Light Company's power stations at Hartford. Should the cost of fuel on such basis be more than $5.55 or less than $5.05 per net ton, then for each one cent increase above $5.55 or decrease below $5.05, the energy charges shall be increased or decreased respectively by 7/10,000ths of a cent per kilowatt-hour."

Q So is it a fact that the energy charge is determined by the cost of fuel to The Hartford Electric Light Company? *A* It is.

Q Has that fact any bearing on your statement that the supply of power by The Connecticut Power Company to The Connecticut Light and Power Company is based on primary firm capacity of The Hartford Electric Light Company? *A* I was not a signatory to this contract, but certainly the officers of both companies who did sign it agreed that the basis of electric energy delivered in Bristol should be affected and determined by the cost of fuel at the plants of The Hartford [*2129*] Electric Light Company.

Mr. Wahrenbrock: Mr. Examiner, in view of the first clause of the witness's response, I move to strike the balance of the response.

Trial Examiner: I think in view of the first clause the balance could be at best hearsay. The motion is granted.

By Mr. Smith: *Q* Mr. Colvin, you testified that the source of energy at Bristol was The Hartford Electric Light Company. That is, the primary source was The Hartford Electric Light Company. Can you give me a reason for that statement?

Mr. Wahrenbrock: Mr. Examiner, I object to this line of inquiry, and to this particular question.

Trial Examiner: Does counsel deny that the witness so testified yesterday?

Mr. Wahrenbrock: Yes, he didn't say anything about the primary source. He may have testified with respect to contract, which designates a source of prime power. He didn't say anything about a prime source of electric energy.

Mr. Smith: I believe he so testified ten or fifteen minutes prior to the recess this morning.

Mr. Wahrenbrock: I have no recollection of any testimony except the testimony with respect to prime power, not anything about a prime source, whatever a prime source is.

Trial Examiner: Well, are you in a position to find the [*2130*] record of what he testified to this morning? Do you have the transcript there?

Mr. Smith: No, I have not, Mr. Examiner.

Trial Examiner: Can the reporter obtain it for us?

Mr. Smith: Perhaps I could ask him that question now.

By Mr. Smith: *Q* What is the prime source of power at Bristol?

Mr. Wahrenbrock: Mr. Examiner, I object to that on several grounds. In the first place, the evidence shows where the power comes from at the times which are significant to this proceeding. It is irrelevant and immaterial where it comes from at other times, or where they could have obtained it from if they hadn't obtained it from where they did obtain it. The important thing is where they do obtain it. That has been shown. Anything else is irrelevant and immaterial and I object to this on that ground. In the second place, it is not indicated what is meant by "prime source". In the third place, the best evidence is the contracts, which are already in evidence.

Trial Examiner: I don't see the materiality but it may be relevant and we will admit it for what it is worth. The witness may answer the question. The objection from Commission counsel is overruled.

A I believe that I testified earlier in this session [*2131*] that the source of firm power for Bristol were the steam stations of The Hartford Electric Light Company, the hydro-capacity at Falls Village, and what reserve capacity might be available at Torrington.

* * * * * * [*2133*]

Q Are you able to say, Mr. Colvin, whether there was a similar energy charge as that described in Article 4 of Exhibit 8 prior to January 1, 1937, between The Connecticut Power Company [*2134*] and The Connecticut Light and Power Company?

Mr. Wahrenbrock: Mr. Examiner, I am constrained to object to that. That is shown by better evidence already in the record, Exhibit 51 for Identification. You don't need to go into that by a witness whose knowledge is, as shown by his previous testimony, limited to what the Exhibits show.

Mr. Smith: I believe, Mr. Examiner, that Mr. Colvin has testified about a verbal understanding.

Trial Examiner: Well, is this a verbal understanding during the period in which there was no contract?

Mr. Smith: He has testified that prior to Exhibit 8 that there was a verbal understanding between The Hartford Electric Light Company and The Connecticut Power Company as to supplying the requirements of The Connecticut Power Company to serve Bristol, is that correct, Mr. Colvin?

The Witness: No, sir.

By Mr. Smith: *Q* Well, with whom was that verbal understanding? *A* I testified that there was a verbal agreement or contract between the contract executed December 16th, 1936, marked Exhibit 8, and the execution of the contract in June, 1937, the Exhibit—subject to help—31, which has just been handed me.

Mr. Smith: 37.

A I haven't the exhibit here, and that your question was [*2135*] whether the one prior to Exhibit 8? To that my answer is "No".

[*2136*] *Q* The verbal understanding. *A* Subsequent.

Q Subsequent to December 16, 1936? *A* Yes, sir.

Q And was that verbal understanding similar to the agreement set forth in Exhibit 37, which you referred to just recently? *A* I have already testified that service was rendered under the terms of the contract dated December 16, 1936, to Bristol, and that the bills for such service were in accordance with that contract and were paid.

Q What was the primary source of supply to The Torrington Electric Light Company? *A* Torrington is fed from the same high voltage transmission line as Bristol, and as of any specific date it had the same firm sources of supply.

* * * * * * [*2137*]

Q Mr. Colvin, you have testified that the primary source [*2138*] of supply at Torrington was The Hartford Electric Light Company; is that correct? *A* And that of the hydro plant of Falls Village, the reserve capacity at Torrington.

Q Now, can you give a reason for stating that? *A* That is stated in Exhibit 36, of which I was one of the signatories, and which states the ownership of certain facilities, and what The Connecticut Power Company may expect from the facilities of others for payments specified.

Q Will you now direct your attention, Mr. Colvin, to Exhibit 73. Can you tell us how far it is from the South Meadow substation of The Connecticut Power Company to the Massachusetts State line, following the route of the Connecticut Power Company's Agawam line?

* * * * * * [*2140*]

Q Mr. Colvin, can you do this quickly? *A* I can take the scale that is shown on the map.

Q Let me ask you this, to hasten it up. Is the portion of the line located in Connecticut from the Massachusetts State line to the South Meadow substation, 27.4 miles? *A* Approximately.

Q And from the Massachusetts State line to Agawam, Massachusetts, is it 6.3 miles?

Mr. Wahrenbrock: I object for the same reason, Mr. Examiner. We are getting on the facilities of an entirely different company.

Mr. Smith: This is one company that Mr. Wahrenbrock did specifically ask about, I believe—the Turners Falls Company.

Mr. Wahrenbrock: Let us see the reference.

Trial Examiner: I think we will permit him to go as far as Agawam. You may proceed.

The Witness: Agawam is not shown on the exhibit handed [*2141*] me, but the distance as quoted is substantially correct.

By Mr. Smith: *Q* From the South Meadow substation to Falls Village, following the route of the line as shown on that map, is it approximately 58.75 miles? *A* I believe that is substantially correct.

Q And from Falls Village to the New York State line, following the route of the Falls Village-Poughkeepsie line, is it 7.86 lines?

Mr. Wahrenbrock: Mr. Examiner, I wish to object to that, and point out that all that information is shown on Exhibit No. 38. And I point out that for the purpose of showing that this is merely cumulative and duplicating evidence already in the record, and I see no purpose for putting it in except to delay the proceedings.

Trial Examiner: The objection will be overruled. Counsel may proceed.

The Witness: The question is from Falls Village to the New York line?

By Mr. Smith: *Q* To Poughkeepsie, the New York State line. Is it approximately 7.86 miles? *A* It is so shown on Exhibit 38.

Q Will you now direct your attention to the map, to the Middletown division, and referring to the former supply [*2142*] by The Connecticut Power Company to Pole 110, will you describe how that was supplied by The Connecticut Power Company? *A* It is shown on the Exhibit 73 for Identification. It is shown in greater detail on Exhibit 38. By formerly, I am referring to the period just prior to the discontinuance of the service at Pole 110.

Q Was that July 1, 1939? *A* June 30, 1939, I believe is the correct date. I am starting at what is known as the West Side substation of The Connecticut Power Company in Middletown, and from—

Q Now, I want to interrupt you there, and ask you what that West Side substation did? *A* The West Side substation at Middletown is the point at which the 66,000 volt circuits of The Connecticut Power Company terminate, and the energy is sent out at nominally 4160 volts and nominally 13,800 volts. There is the necessary building transformers, and so forth, installed at that point. The energy that formerly went to Pole 110 prior to its disconnection, left the West Side substation by underground cable, and then crossed the Connecticut River at that time in submarine cables, and came up on wood poles, and went to what is designated as the Wolcott Lane substation, located in the Town of Portland.

Q Did any other circuits of The Connecticut Power Company come out of that West Side substation? [*2143*] *A* Yes, sir.

* * * * * * [*2145*]

Q Will you, Mr. Colvin, now describe whatever lines came out of, first, the Middletown substation? *A* By Middletown substation, reference is again made to the West Side substation located in Middletown. That station supplies the City of Middletown and the surrounding towns. Our distribution in Middletown falls in two voltage classifications—really three at the present moment, in that we are in the process of changing over completely to 4,160 volts, three-phase, but still have a small amount of two-phase remaining. We have a 13,800 volt distribution system that carries the larger factories, and carries the major or the larger part of the energy that we sell at retail in Middletown and the surrounding towns. From this 13,800 volt bus in the West Side substation, underground cables, and then submarine cables, and then aerial cables [*2146*] carried it to the Walcott Lane substation where there were several circuits. Some of those circuits supplied fac-

tories at 13,800 volts, others supplied domestic customers, commercial customers, small power customers in the Town of Portland at 4,160 volts. One circuit continued to pole 110, supplied a group of residential customers on the way, and up until the ownership of certain facilities changed in the Town of Portland, there were transformers installed at what is now shown as Collins Hill, in about the center of the map, three inches from the bottom.

The customers served from Collins Hill were formerly customers of The Connecticut Light and Power Company, and are now customers of The Connecticut Power Company. Leaving pole 110 was a circuit that continued, I believe, served East Hampton and the surrounding territory.

[*2147*] By Mr. Smith: *Q* Do I understand there are taps serving customers off this line running from Wolcott Hill to Pole 110? *A* As of the date of the termination of the contract there was a tap serving a group of residential customers.

Q Can you tell us with reference to this diagram here, 4031-F, how far it is from South Meadow over to Pole 110? Will that take you very much time? *A* I think the only thing I can do is drive it in an automobile.

Q Could you just give us an approximation? *A* On the assumption by the way the line goes?

* * * * * * [*2148*]

Q By referring to Exhibit 38, Mr. Colvin, can you just approximate first the distance from South Meadow along the 66 k. v. line to the Middletown tap? *A* From the South Meadow substation to the Middletown tap, Exhibit 38, shows a distance of 11.04 miles.

Q From the Middletown tap down to the Middletown West Side substation, how far is that?

* * * * * * [*2149*]

A Exhibit 38 shows a distance of 11.04 miles from the South Meadow substation to the Middletown tap, which is known as Point 12.

Trial Examiner: Why can't we save time, Mr. Smith, by getting a statement in the record from the witness? If you want to ask him if all the distances shown on Exhibit 38 are correct, I see no reason for not doing it that way, but I think that would shorten the whole procedure and save going into the question of individual distances.

Mr. Smith: The trouble is, all of the distances are not shown on this map.

By Mr. Smith: *Q* Are all the distances shown on the map correct, Mr. Colvin? *A* All the distances that are shown on the map are taken from the records in our engineering department, and we regard them as correct.

Q Is the distance, the total distance from South Meadow to Pole 110, can that be computed on this map? *A* It cannot be computed from Exhibit 38.

Q Why not? *A* It was testified that Exhibit 38 was a diagram and not [*2150*] a map.

Q Can you get the distance on Exhibit 38 from South Meadow to Middletown? *A* Yes, sir.

Q Can you get the distance on Exhibit 38 from Middletown to Pole 110? *A* No, sir; not on Exhibit 38.

Q Would you give us that distance quickly? *A* Of the order of 5 to 6 miles.

Q Is the distance from South Meadow to the Bristol tap shown on the map? *A* It is shown in various sections, and it is necessary to combine the readings to obtain the total distance.

Q And is the distance from South Meadow to Torrington shown on the map? *A* It is shown in several sections and it is necessary to combine them to get the total distance.

Mr. Wahrenbrock: I understand that counsel's question refers to Exhibit 38.

Mr. Smith: I beg your pardon. Yes, in all instances.

Trial Examiner: Yes, that is so understood. Did you answer, Mr. Colvin?

The Witness: I did, sir.

By Mr. Smith: *Q* And can you figure from Exhibit 38 the distance from [*2151*] Torrington to Falls Village and from Falls Village to Poughkeepsie? *A* It is given from Tower 276 to Falls Village, and it is given from Falls Village to the New York State line on Exhibit 38.

Mr. Smith: No further questions.

Trial Examiner: Any redirect, Mr. Wahrenbrock?

Mr. Wahrenbrock: Yes, Mr. Examiner, a few questions.

Redirect Examination by Mr. WAHRENBROCK.

Q Mr. Colvin, I direct your attention to Exhibit No. 73 for identification, and ask you to point if you will, please, the mode by which this Exhibit purports to identify the point of delivery from The Connecticut Power to The Connecticut Light and Power Company for the latter's Bristol load. *A* It would be indicated by the letter "C" in the town marked "Bristol City".

Q Is the use of a letter the mode of indicating interconnections on this map? *A* The various points on the map are explained under the legend and indicated by a letter or a numeral.

Q How does this map show the point of delivery from The Connecticut Power Company to The Connecticut Light and Power Company to supply the requirements of the latter for the latter's East Hampton District prior to July 1, 1939? [*2152*] *A* If you will refer to the map, to the town marked Portland, and with a triangle, and underneath the legend the number "14" you will find that it is called the Collins Hill substation, and Pole 110 was located a short distance southerly from that point.

Q Is there anything to indicate on the map the position of Pole 110? *A* There is not.

Q Is there any legend on the map to indicate, or any symbol on the map to indicate the existence of a point of delivery at or near Pole 110 of The Connecticut Light and Power Company? *A* There is not.

Q The map does not show a point of delivery to the Connecticut Light and Power Company for the latter's East Hampton dis-

trict? *A* It does not, but I testified that the map was correct as of this date, with the exceptions that I noted.

Q As of what date? *A* As of this date, in July, recalling to you the change of ownership of the lines shown in the town of East Hartford, with the letters "G" and "L".

Trial Examiner: Has the witness completed his answer?

The Witness: That is the only one that occurs to me, but I had in mind that I found the second one, but I cannot [*2153*] find it again at this time, if I had it in previous testimony.

Mr. Wahrenbrock: I would like to have that answer read back to me, please.

Trial Examiner: Will you read the answer for the benefit of Commission counsel?

(The answer is read by the reporter.)

By Mr. Wahrenbrock: *Q* Mr. Colvin, aside from the exception which you mentioned at the points represented by the symbols "G" and "L", having in mind your reservation of that exception, your prior testimony in response to Mr. Smith's questions that Exhibit 73 for identification accurately represented the facilities of The Connecticut Power Company must be subjected to the further qualification that it does not accurately represent those facilities at Pole 110 prior to July 1, 1939, isn't that true? *A* I have testified that the map does not show Pole 110.

Mr. Wahrenbrock: Mr. Examiner, I ask that on the basis of the testimony thus far elicited, Exhibit 73 for identification be not admitted in evidence.

Trial Examiner: I think he stated that it represented the situation at the present time. I don't understand that Pole 110 connection exists today. Is that correct?

Mr. Wahrenbrock: Mr. Examiner, the questioning by the respondent's counsel attempted to establish that this represented the facilities from August 26th, 1935 to the present time and [*2154*] that the map itself does not contain any date or legend which would rebut or show that that was not what it purported to represent.

Mr. Smith: Mr. Examiner, I think that in any of these diagrams, with particular reference to the one-line diagram offered by Commission's counsel, none of these diagrams in a utility can depict a situation at one particular time, they are not static, and Mr. Colvin has given sufficient explanation, so that this map is simply a map which shows in general outlines the C.P. lines about which we have heard so much talk in relation to the map of the State of Connecticut, and was offered for that purpose.

I think the only other evidence which has been offered is the one-line diagram, and that is the purpose.

Trial Examiner: If the map is only offered for that purpose, it will be received in evidence as Exhibit Number 73.

(Document previously marked Exhibit 73 for Identification was marked Exhibit Number 73 in Evidence.)

Mr. Wahrenbrock: I expect that I will be able to conclude with this matter in a matter of ten minutes or more, so that we can adjourn at our usual hour.

Trial Examiner: All right, you may proceed.

By Mr. Wahrenbrock: *Q* Mr. Colvin, I would like to direct your attention to your testimony in response to questions by Mr. Smith, in which [*2155*] you referred to the C.P. 1 and C.P. 2 lines as terminating through transformers on the 66 k. v. bus at Falls Village, and ask you to explain what you meant by that expression, if you will. *A* If I may refer you to Exhibit 38, in the upper left-hand corner, there is the designation of the Falls Village station, and it shows the C.P. No. 2 at the top of the sheet, C. P. No. 1 at the bottom of the sheet, coming through suitable oil switches and terminating on a heavy line which is marked "6.6 k. v.".

Q That is the point I wanted to clear up. It doesn't terminate on a 66 k. v. bus through transformers, does it? *A* The 66 k. v. lines are connected by a disconnecting switch shown above the word "Hydro".

Q Then your statement that the C. P. 1 and C. P. 2 lines ter-

minate through transformers on the 66 k. v. bus is not accurate? *A* If I said 66 k. v. bus I wish to correct it to read 6.6 k. v. bus.

Q In making the statement that you did with respect to the 2,300-volt facilities of The Torrington Electric Light Company, did you mean to be understood as saying that any customers of that company are served at 2,300 volts? *A* I believe certain of the customers are served at 2,300 volts.

[*2156*] *Q* What companies? *A* I believe the Torrington Company is served at 2300 volts.

Q Any others? *A* That is the one that I had recalled immediately.

Q At what voltage are most of the customers of The Torrington Electric Light Company served? *A* I testified that my knowledge of the Torrington distribution system was a general one. I assume the residential customers are served at the usual residential voltage, maybe either nominally 110 or 110-220. The power customers are served with whatever voltage meets their requirements, as far as metering and delivery goes.

Q I wish to refer to Exhibit 37, which is the contract of June 8, 1937, I believe, and to your testimony with respect to the situation prior to the execution of that contract. I believe you referred to it as a verbal understanding. *A* May I see the exhibit?

Q I thought it was before you there. You referred to it on cross-examination. *A* I gave everything I had, I think, back.

Q Yes. I show you Exhibit 37. Now, will you explain about this verbal understanding? When was it entered into? *A* I testified that through error on the part of Mr. Barney or the witness, or both, no contract was made on or [*2157*] December 16, 1936, by which The Connecticut Power Company was guaranteed a supply of power for delivery to The Connecticut Light and Power Company at Bristol. I testified that we did obtain such power from The Hartford Electric Light Company. We did deliver and we were paid for it. That we operated under what you might term a verbal understanding or verbal contract.

Q Yes. Now, I want to understand what you mean by verbal

understanding or verbal contract? *A* I assume that a verbal understanding or verbal contract—

Q Well now, Mr. Colvin, I am not asking for any assumption. I want to know what you know about that verbal contract or verbal agreement? *A* The Connecticut Power Company rendered, received bills from The Hartford Electric Light Company, monthly bills, which were satisfactory to us, and in accordance with our understanding, and we paid them to The Hartford Electric Light Company.

Q In accordance with what understanding? *A* The understanding that is outlined in the formal agreement dated June 8, 1937.

Q But that understanding which is outlined in Exhibit 37 hadn't then been executed, had it? *A* It had not.

[*2158*] *Q* Then do you mean to say that the bills which were rendered prior to June 8, 1937, were rendered in accordance with the contract which was entered into after June 8, 1937? *A* My understanding is that the formal contract of June 8, 1937, is the reduction to writing of the agreement that had been in operation before that date and subsequent to January 1, 1937.

Q All right. Now, that agreement which had been in operation, you say, prior to June 8, 1937, what kind of an agreement was that? *A* That was an agreement under which the officers of The Connecticut Power Company understood that the requirements for the Bristol district of The Connecticut Light and Power Company were to be supplied by The Hartford Electric Light Company, and in fact were so supplied, and the price to be paid for them was based on a demand and energy charge, and the point of delivery from The Hartford Electric Light Company was specified, and The Connecticut Power Company was enabled to carry out its contract of December 16, 1936, with The Connecticut Light and Power Company.

Q Aside from the fact that the energy was received and that it was paid for on a certain basis, have you any knowledge of any agreement for the delivery or receipt of that energy on that basis?

A I have already testified that either through neglect [*2159*] on the part of Mr. Barney or myself, or both, that the contract of June 8, 1937, was not executed at or about the time the contract of December 16, 1936, covering the supply of energy by The Hartford Electric Light Company to The Connecticut Power Company for its other uses, was signed.

Q Yes. Now, what I want to get at is whether, when you speak of an understanding or a verbal agreement or a verbal contract, you have any knowledge of anything more than the fact that the energy was received and paid for. Now, can you just answer me that? Do you know anything else about any such agreement or contract other than that the energy was received and paid for? *A* I know that Mr. Barney stated that there should be a formal agreement covering the existing arrangement.

Q Now, do you know anything else besides that? *A* No, sir.

Q Then, as far as you know, there had been, prior to the receipt and payment for that energy, no meeting of the minds between the two companies as to whether it would be furnished, and what there should be paid for it?

Mr. Smith: I object to that question, as leading, and assuming a state of facts not in evidence.

Mr. Wahrenbrock: All right, I will withdraw it.

Trial Examiner: The question has been withdrawn.

The Trial Examiner would like to ask one question at [*2160*] this point.

You talk about an understanding. Who was that understanding between, Mr. Colvin, as representatives of the two companies?

The Witness: The understanding included Mr. Ferguson, Mr. Bird, Mr. Colvin, and through to the billing and paying departments of the respective companies.

Trial Examiner: When was that agreement reached?

The Witness: The agreement was a continuing one that had existed for many years, and I am sure that The Hartford Electric

Light Company always felt its understanding to supply power to the Bristol district of The Connecticut Light and Power Company.

Trial Examiner: As I understand you, there was no time at which representatives of the two companies sat down at the table, or met somewhere on the street, and said, "We will do this if you will do that?"

The Witness: The officers of the two companies, The Hartford Electric Light Company and The Connecticut Power Company are together several times a week, sir.

Trial Examiner: Well, did they come to any definite agreement as to this?

The Witness: It was not discussed until shortly before June 8, 1937, as a contract.

Trial Examiner: Counsel may proceed.

[*2161*] By Mr. Wahrenbrock: *Q* I direct your attention, Mr. Colvin, to the line from the Walcott Lane substation in Portland to pole 110, and specifically to that line as it existed from August 26, 1935, until June 30, 1939, and ask you how many taps there were on that line? *A* I know there were a group of ten or a dozen houses served from it. I don't know whether there was more than one tap on the line or not.

Q Isn't it a fact that they were served from a single transformer tap, a former tap from that line at that one point? *A* I told you I didn't know whether there was more than one tap or not.

Q Isn't the statement I made to you the statement made to me in your company when, in the presence of some other Commissioners, I was viewing those facilities? *A* Mr. Hippler talked with you when you were in the vicinity of pole 110. The discussion covered the service to a Mica Company that is there now, a manufacturing company, and covered the service to residential customers. I do not recall the point as to whether the 11,000 volt line was tapped at more than one point being asked or answered.

Q What was the phase of the line from Walcott Lane to pole 110? *A* Three-phase.

[*2162*] *Q* What was the phase served to the residential cus-

tomers that you have spoken of, the ten or a dozen of them that you speak of? *A* As far as I know single phase.

* * * * * * [*2164*]

Q Do you know whether any of those taps on the 13,800 volt line were in existence and connected after the date in the spring of 1936 when the New Britain interconnection of The Connecticut Power and The Connecticut Light and Power Company was discontinued? *A* I have no means of ascertaining specific dates without a search of the actual work orders that were done on those taps. I know personally that the so-called Pecauset tap, [*2165*] which was the first one, was in existence in the early 1930s and persisted until the highway was reconstructed in connection with the new Portland-Middletown bridge, which I would believe was in 1938 or 1939, because I passed that particular section in my travels.

Q Was that after the 1938 hurricane? *A* I cannot answer whether the line was damaged in the 1938 hurricane or not. Everything in general was.

Trial Examiner: I don't think the question, Mr. Colvin, was whether it was damaged. I understood the question was whether that was after the hurricane.

The Witness: I cannot relate it to the hurricane in September, 1938.

By Mr. Wahrenbrock: *Q* How are those residences or residential customers at those places served at present? *A* At the present time we have added on the poles in that section a lower voltage network or system which takes those customers and others that have since come on, and they are served from the feeder from the Walcott Lane substation at 4160 volts nominal pressure.

Q That is, the customers are served at 110 stepped down from 4600? *A* Our standard service is 110-220 volts, three wire nominal secondary voltage. This particular system is 4160 [*2166*] volts Y connected, which is 2300 volts from the neutral to the outside and 4160 volts between phase wires.

Q And those 4160 circuits have been added without removing the 13,800 volt lines? *A* The line still remains on the same poles. The transformers which formerly energized the lower voltage circuit have been removed.

Q Were all of the residential customers served from these transformers at these three taps to which you have referred, served at single phase? *A* As far as I know, all residential service is single phase, and is so stipulated in our rates.

Q In order to serve them at single phase, it was not necessary to have a three-phase, 13,800 volt circuit, was it? *A* They might have been served from any other circuit. A single phase circuit would have provided an adequate supply.

Q Two of the three phases were unnecessary to serve that—

Q One of the three wires was not necessary. It takes two wires to have a single phase circuit. It takes three wires to have a three-phase service.

Q One of the wires then was not necessary? *A* Was not necessary.

Q What was the approximate length of the line from pole 110 to East Hampton? [*2167*] *A* I do not know, sir. That was the property of The Connecticut Light and Power Company. An exhibit was shown me a week ago Monday, on which that line was indicated. A Government map.

Q Well, do you know from your own knowledge? *A* The highway does not follow the route of the pole line.

Q Well, don't you know approximately how far—whether it was a matter of one mile or five miles or ten miles? *A* Oh, a matter of ten or fifteen miles.

* * * * * * [*2174*]

HAROLD E. MILLER.

Direct Examination (Resumed) by Mr. WAHRENBROCK.

Trial Examiner: You will note the witness is being recalled for further testimony. He does not need to again be sworn.

Q You are Harold E. Miller, who had previously testified in this case? *A* I am.

Q I show you a copy of Exhibit 60 for Identification, and ask you if that was prepared under your direction. *A* It was.

Q On the basis of what data and information did you prepare that, or was that prepared? *A* I made up the rough sketch from which this was prepared, in the drafting room under my direction, from the report of The Connecticut Power Company's annual power system statement for the year 1940, and also in that report there is a copy of the one-line diagram which has since been identified, I believe, as Exhibit 38. This Exhibit 60 is in accordance with Exhibit 38 in so far as it shows the lines of The Connecticut Power Company and The Torrington Electric Light Company.

The Winsted substation shown is as it is, a one-line diagram based on certain sketches I made at the time I visited the Winsted substation, and I believe that covers the basis of the [*2175*] diagram.

Q What does the diagram represent? *A* The diagram represents in one-line form the lines of The Connecticut Power Company from Massachusetts to the South Meadow substation, along the C. P 1 and C. P. 2 lines to Falls Village. It shows the E-line running to the Central Hudson Gas and Electric Corporation. It shows the connection to The Hartford Electric Light Company at South Meadow. It shows the Middletown tap and the circuits at West Side substation at Middletown. It shows the Bristol substation of The Connecticut Light and Power Company. It shows the substation of the Thomaston division of The Connecticut Power Company. It shows the substation at Torrington of The Connecticut Power Company and The Torrington Electric Light Company.

In this connection I wish to state that there is no attempt made at Torrington to in any way indicate ownership changes. It also shows the substation at Torrington of The Connecticut Light and Power Company. It shows the Winsted substation of The Connecticut Light and Power Company. It shows the Robertsville plant of The Connecticut Light and Power Company.

It shows the Falls Village Plant and substation, and I believe I have covered most of the information contained on this one-line diagram.

[*2176*] *Q* Does the diagram purport to show, and does it show, all disconnections, metering points and appurtenant facilities to those you have described? *A* The diagram does not attempt to show the switching in general. There are a few switches that have been placed in the diagram where it was felt that it might be necessary in referring to this diagram to be able to point to those switches; but switches in general were left off because they would complicate the diagram, which was devised primarily to enable showing directly the connections between The Connecticut Power Company and other companies.

Q As of what period of time does the exhibit 60 represent the facilities which it purports to represent? *A* With respect to the lines from Massachusetts to South Meadow and the connections at South Meadow substation, and the CP 1 line and the Falls Village plant, it represents, in so far as I was able to determine, the situation for the period since the Federal Power Act, which was in August, 1935, became effective. With respect to the Middletown division it shows the West Side substation from the time that substation was put into effect. With respect to the Portland, there is a note on it that indicates a connection with The Connecticut Light and Power Company prior to July 1, 1939. [*2177*] With respect to Torrington it shows the condition at Torrington since the installation of the 15,000 k.v.a. three-phase transformers at Torrington. In respect to Winsted substation it represents the conditions existing at least at the time of my visit at Winsted, and from what I could determine at that point, for some period prior to that.

Q And what date was that? *A* That was in May of 1941 that I visited the Winsted substation.

* * * * * * * [*2178*]

Cross Examination by Mr. SMITH.

Q I believe your said, Mr. Miller, that the C-3 and D-4 lines

shown on Exhibit 60 were as they were on August 24, 1935, and from that time to date? *A* Did I say August 24th? I don't believe I did.

Q I thought you did. From what date did you say? *A* I did say that from the approximate time of the Act, when the Act went into effect. I did not specify that I understood there was a period of time between August, 1935 and some time in April, 1936, or thereabouts, or March, 1936, when that line was opened at the Massachusetts border.

Q Well, this exhibit as to the C-3 and the D-4, and the E line, does not attempt to show an addition to those lines during the time that they were cut, does it? *A* No, it doesn't.

Q Now, the D-4 line at the present time, and since March of this year, is not as it is shown on this Exhibit 60, is it? *A* No, I believe in my direct testimony I had clearly stated that the D-4, some time in March, 1941, had been [*2179*] changed from 66 k.v. operation to 110-115 k.v. operation. In discussing it now, I was briefly describing this thing—I thought that anything I had said previously would be considered as part of my explanation.

Q And you have also stated that few, if any, switches are shown on this exhibit? *A* That is correct.

Q Is it fair to say that this one-line diagram, with the exception of the Winsted substation, and the Bristol substation, is the same as Exhibit 38, but in much less detail, showing you Exhibit No. 38, the one-line diagram of The Connecticut Power Company? *A* I would not say it is the same. I think the arrangement of this diagram more clearly illustrates the lines showing connections with Massachusetts and with New York than can be obtained from Exhibit 38, without considerable study.

Q But Exhibit 38 does show the switches, does it not? *A* Exhibit 38 does show the switches.

Q And is more detailed as to such matters on the lines, such as switches, meters, and so forth, is that correct? *A* I have stated that Exhibit 38 does show the switches.

Q And is more detailed? *A* It is all a matter of what diagram is prepared for. The question of switching is not involved in making this diagram, but this diagram is prepared for the purpose of [*2180*] enabling someone to very quickly trace connections between The Connecticut Power Company from Massachusetts to South Meadow station along the CP1 and CP2 lines to Falls Village, and to the New York State line, and I think that serves that purpose much more clearly than Exhibit 38. Exhibit 38 shows many other connections of The Connecticut Power Company and CP1 and CP2 lines, and to that extent may be very confusing.

Q You mean, this was prepared not to show the facilities, but to show this set of facts? *A* It does show the facilities, but it shows them in a much more clear manner than the Exhibit 38 does.

Q Directing your attention to Exhibit 60, the West Side substation, 13.8 k.v. bus, you show one line going to Portland. There are others, aren't there, going off of that 13.8 k.v. bus? *A* I don't recall at the present moment whether there are others.

Mr. Wahrenbrock: I am sorry, Mr. Examiner, I can't hear.

Trial Examiner: Will both the witness and the respondent's counsel speak just a little louder. There is a good deal of noise outside which is competing with you. Will you repeat that question and answer for the benefit of Commission's counsel.

(Whereupon the last question and answer as above recorded, were read by the reporter.)

[*2181*] The Witness: I desire to amplify that statement by adding that you will note that a connection is shown there on the 13.8 k.v. bus, a line shown within the outline of the substation to Portland. No attempt is made to show the line crossing the river, or going to pole 110. It was felt for the purpose of this diagram that it was sufficient to show that from the West Side substation from the 13.8 k.v. bus, there was a circuit to Portland,

and to The Connecticut Light and Power Company, prior to July 1, 1936.

By Mr. Smith: Are there other circuits going out of that 13.8 k.v. bus? *A* I believe there is an alternate circuit that does go off through some special switching arrangement, that also goes to Portland, but I don't believe it comes directly from the bus, but through some special switching arrangement that might be quite confusing if an attempt is made to show them.

Q Are there any other circuits that run off this 13.8 k.v. bus shown at Middletown division and as shown here? *A* I believe there are, to The Connecticut Power Company's system.

Q Thank you. Will you now direct your attention to the substation at Bristol, and your attention to the 13.8 k.v. bus shown there. Are there any other feeders that run off that bus? *A* I haven't made any attempt to show feeders in any [*2182*] of the substations on this diagram. I was not— in making this diagram—attempting to show the distribution system of the companies in each one of the substations. In every case I have only shown the substation buses, and any connections between the company owning that substation and any other company. But I have not shown circuits going to various feeders of which there are probably a great many at Bristol, or any of the substations of The Connecticut Power Company.

At South Meadow I have only shown the high voltage circuit. I haven't shown all the circuits going off the 11 k.v. bus of The Hartford Electric Light Company. It wouldn't have added anything to the diagram. It would have made it confusing for the purpose for which this diagram was made.

[*2183*] *Q* So this is a one-line diagram then not of the system of any of the companies listed under the legend, but simply a one-line diagram showing only certain of the facilities? Is that correct? *A* This is a one-line diagram intended to show the correct connections of The Connecticut Power Company at the Massachusetts line and at the New York line and the connections with other companies and its connections with The Connecticut Light

and Power Company either directly or through other companies along the C.P. 1 and C.P. 2 lines, and I can't characterize it in any other way.

* * * * * * [*2190*]

RICHARD B. CURRAN,

a witness called on behalf of the Federal Power Commission, being first duly sworn, testified as follows:

Direct Examination by Mr. WAHRENBROCK.

Q Mr. Curran, will you please state your full name? *A.* Richard B. Curran.

Q Your business address? *A* 31 Union Street, New London, Connecticut.

Q And your home address? *A* 807 Ocean Avenue, New London, Connecticut.

Trial Examiner: Is that C-u-r-r-a-n?

The Witness: That is right, sir.

By Mr. Wahrenbrock: *Q* What position do you hold with The Connecticut Power Company? *A* Secretary and Treasurer.

Q How long have you held that position? *A* Since January or February, 1932.

Q 1932? [*2191*] *A* Yes.

Mr. Wahrenbrock: I show respondent's counsel two letters in the file I hand him marked by clip.

Mr. Branch: One a letter to the Power Commission and the other a copy of a letter from the Power Commission?

Mr. Wahrenbrock: That is right.

Mr. Branch: Have you copies of those?

Mr. Wahrenbrock: I do not. I propose to ask one or two questions about them.

By Mr. Wahrenbrock: *Q* Mr. Curran, I call your attention to a carbon copy in one of the files of the Federal Power Commission which bears the date June 28th, 1939, being a carbon copy of a letter addressed to The Connecticut Power Company, attention Mr. Allan D. Colvin, over the signature of Leon M. Fuquay, Secretary, and ask you if you recall receiving the original of which

that is a carbon copy, and in that connection, I call your attention to an original of a letter addressed to the Federal Power Commission under date of July 11th, 1939, on the letterhead of The Connecticut Power Company, and signed "The Connecticut Power Company, R. B. Curran, Secretary and Treasurer".

With reference to the last letter, I ask you if that is your signature. *A* Yes, sir.

Q Do you recognize both of the letters? [*2192*] *A* I think I do.

Q Did you receive the letter under date of June 28th from the Federal Power Commission? *A* I think it was received in the office while Mr. Colvin was away.

Q And referred to you for attention? *A* Yes.

Q And the letter of July 11th, 1939 is the letter which you prepared and sent in reply thereto? *A* Yes, that I prepared, based on information supplied to me, I think, by Mr. Ferguson, the president of the Company.

Q I call your attention to the fourth paragraph of Mr. Fuquay's letter of June 28th—

Mr. Branch: May I look on with you?

Mr Wahrenbrock: Yes, indeed.

By Mr. Wahrenbrock: *Q* Which reads as follows:

> "4. Indicate periods in the year 1938 when operating and water conditions at the Falls Village plant made it necessary to supply The Connecticut Light and Power Company at Bristol with energy received by your company from The Hartford Electric Light Company and from Turners Falls Power Company through the Connecticut Valley Exchange."

And I ask you to read the reply which you made to that paragraph 4.

[*2193*] Mr. Branch: I object to this. I don't think this is the proper way to put in evidence, reading a letter that this gentleman wrote to the Federal Power Commission.

Trial Examiner: It seems to me that it may be admissible for showing his statement at the time.

Mr. Branch: I don't see that his statement at the time is material. Can I put in any letter that anybody writes to the Federal Power Commission, as evidence of the facts, or anything else? It seems to me that violates one of the fundamental rules of evidence.

Trial Examiner: The witness is being asked whether he made certain statements. I think he may properly be asked whether he made certain statements. They are his own statements they are not somebody else's.

Mr. Branch: Well, sir, I think he said "on information supplied to him." It doesn't appear that he had any first-hand knowledge of the situation.

Trial Examiner: Apparently he made a statement. That is all he is being asked,—what the statement was that he made.

Mr. Branch: Yes, sir. But it seems to me—

Trial Examiner: It seems to me the question of the sources of his information can be explored on cross-examination.

Mr. Branch: Yes, sir.

Trial Examiner: The witness is here, and subject to the right of cross-examination. It is not a matter of a letter being [*2194*] introduced in his absence.

Mr. Branch: No, sir; but in my experience I never heard of a letter which wasn't addressed to us being put into evidence, a letter between two other parties.

Trial Examiner: I don't think this is being introduced for the purpose of showing any statement.

Mr. Branch: I don't think it is material, sir, what statement he made, otherwise we could put any witness on the stand and say "Did you say to John Smith this thing yesterday"? "Yes". Then it is in evidence. That seems to me just—

Trial Examiner: The witness is an officer of the company from whom your client was obtaining power, with whom they had

physical and contractual relations. It seems to me that the question of the statements made at the time may well be relevant.

Mr. Branch: Well, if that is your view, I wish to persist in my objection, but I won't argue it further, sir.

Trial Examiner: The objection is overruled and an exception will be noted.

Mr. Wahrenbrock: May the reporter read the question for the benefit of the witness?

Trial Examiner: The question will be read back to the witness.

(The question is read by the reporter.)

A "It was never necessary to use power from Turners Falls [*2195*] for Bristol in 1938.

"In practice, Bristol is usually served with commingled energy generated at Falls Village."

Mr. Branch: Can you speak a little louder?

The Witness: (Continuing) "Hartford and Turners Falls, in varying amounts, according to conditions, rather than to pond at Falls Village for Bristol requirements. In every month the energy put on the line from Falls Village and Hartford was greater than the Bristol requirements."

[*2196*] By Mr. Wahrenbrock: *Q* I will now read to you from Mr. Fuquay's letter of June 28th, the request numbered 6 therein, and ask you what reply you made to that request:

"6. If there were any operating factors or equipment, or arrangement which prevented in 1938, the energy received by your system from Massachusetts on the 66 k.v. bus at South Meadow substation from reaching the interconnections at points 'C' and 'D,' and being delivered to The Connecticut Light and Power Company, please set forth in detail such condition."

Will you state what answer you made to that inquiry?

Mr. Branch: The same objection.

Trial Examiner: The objection is overruled. An exception will be noted.

The Witness: "No such factors or equipment in 1938. The load dispatcher is responsible for seeing the 66 k.v. bus at South Meadow is always energized by Hartford or Falls Village. That is, that there shall be on the line at all times either exclusive Connecticut generated energy, or commingled Connecticut and Massachusetts energy; never Massachusetts generated energy alone."

Mr. Wahrenbrock: Do you care to refer to that further, Mr. Branch?

Mr. Branch: Have you finished your examination of the witness?

[*2197*] Mr. Wahrenbrock: I think so.

Mr. Branch: Yes, I would like to refer to it during the cross-examination.

Mr. Wahrenbrock: Just a minute. I have no further direct examination, Mr. Examiner. I show the letters referred to to Mr. Branch.

Trial Examiner: The witness is yours for cross-examination, Mr. Branch.

Mr. Branch: Yes, sir. May I stand by the witness to ask him?

Trial Examiner: You may.

Cross Examination by Mr. BRANCH.

Q I call your attention to this letter, and ask you whether question 5 was as follows/ in the letter from Leon M. Fuquay, secretary of the Federal Power Commission, to the Connecticut Power Company, Attention of Mr. Colvin—

Mr. Wahrenbrock: Without making a formal objection—

Mr. Branch: May I not finish? I didn't interrupt you.

Trial Examiner: Permit counsel to finish the question before the objection is made.

By Mr. Branch: *Q* I call your attention to this copy of the letter from Leon M. Fuquay to The Connecticut Power Company,

addressed to the attention of Mr. Allan D. Colvin, executive vice-president [*2198*] dated June 28, 1939, and ask you whether the paragraph numbered 5 reads as follows:

> "Give if possible an estimate of the amount of Massachusetts energy delivered by your system to The Connecticut Light and Power Company at Bristol."

And I ask you whether you answered that in the following language, under the heading Item 5 in your letter of July 11, 1939, to the Federal Power Commission:

> "No estimate is possible. It is not possible to identify power delivered at any particular point as being generated at any particular place when power from several sources is commingled on a transmission system. None was necessary."

Was that your answer? *A* Yes, sir.

Q And was that your best information at that time? *A* That was the best information that I received, yes, sir.

Mr. Branch: Have you the map that is referred to here, referring to points E, F and G?

Mr. Wahrenbrock: I will have to examine it for a moment and see. That is form 64, for the period 1938.

Mr. Branch: Will you be looking that up, or ask your assistant to do it, while I glance through the letter?

Mr. Wahrenbock: I will be glad to.

[*2199*] By Mr. Branch: *Q* I direct your attention to a sheet which is apparently attached to the letter of July 11, 1939, from you to the Federal Power Commission, under the heading, "Column 1", and direct your attention to the last column, "266 k.v. interconnected section, point F", and that aggregate 89,598,000 kilowatt hours. According to your best information, was that the amount of energy which you regarded as received by your company from The Hartford Electric Light Company that month, which was delivered at that point? *A* I don't know what point

"F" refers to, and I am quite sure this information was supplied to me by the engineering or statistical departments, so I am not too familiar with the figures that are in there.

Q All right, never mind. Is it true then that you yourself had no knowledge of any of these matters? *A* I might answer that by saying that I attempted to have the letter answered for Mr. Colvin in his absence, and received the information, I believe, from Mr. Ferguson to write the letter.

* * * * * * [*2201*]

Q Mr. Curran, I call your attention to the copy of the letter from the secretary of the Federal Power Commission to The Connecticut Power Company, June 28th, 1939, and ask you whether the first part reads as follows:

> "In connection with a study now being conducted by the Federal Power Commission concerning the origin and flow of the energy delivered by your company to The Connecticut Light and Power Company near Bristol, Connecticut, you are requested to submit the following:"

Is that the way that letter begins? *A* Yes, sir.

Q I call your attention to your answer, to Item 4, which apparently is in answer to this paragraph of the letter from the Secretary of the Federal Power Commission to your company:

> "Indicate periods in the year 1938 when operating and water conditions at the Falls Village plant made it necessary to supply the Connecticut Light and Power Company at Bristol with energy received by your Company from the Hartford Electric Light Company and from Turners Falls Power Company, through the Connecticut Valley Exchange."

Did you answer that as follows:

> "It was never necessary to use power from Turners Falls for Bristol in 1938."

[*2202*] Is that the first sentence of your reply to that? *A* Yes.

Q And then the sentence that Mr. Wahrenbrock read headed "In practice" and so forth? *A* Yes.

Q And then this sentence, which I think was not read:

> "In every month the energy put on the line from Falls Village and Hartford was greater than the Bristol requirements."

Was that your reply? *A* It was.

* * * * * *

Q Did you make the following statement in your letter to Mr. Fuquay, the secretary of the Federal Power Commission, [*2203*] dated July 11, 1939:

> "The load dispatcher is responsible for seeing that the 66 k. v. bus at South Meadow is always energized by Hartford or Falls Village, *i.e.*, that there shall be on the lines at all times either exclusively Connecticut-generated energy or commingled Connecticut and Massachusettts energy, never Massachusetts-generated energy alone."

Did you make that statement? *A* May I ask if you read this line here, Mr. Branch?

* * * * * *

By Mr. Branch: *Q* Did you make that statement, in answer to an inquiry [*2204*] in the paragraph numbered 6 of Mr. Fuquay's letter to The Connecticut Power Company? *A* I did, in reply to the letter dated June 28th, 1939.

Q And was that—

Trial Examiner: Will the witness speak just a little louder?

The Witness: I am sorry. I did, in reply to the letter dated June 28th, I believe it is, 1939.

By Mr. Branch: *Q* And is that in accordance with your understanding of the facts? *A* It is in accordance with what was furnished me as the facts by Mr. Ferguson, as president of the Company.

Q Now, in order that there be no contention that I have tried to conceal anything, I will ask you this:

Was there another sentence above that in answer to Item 6: "No such factors or equipment in 1938"? *A* There was.

Q And that was a reply to the following, in Mr. Fuquay's letter to you reading as follows:

> "If there were any operating factors or equipment or arrangement which prevented in 1938 the energy received by your system from Massachusetts on the 66 k. v. bus at South Meadow substation from reaching the interconnections at Points C and D [*2205*] and being delivered to the Connecticut Light and Power Company, please set forth in detail such conditions."

Is that a correct statement? *A* That is right.

Q And the longer sentence beginning "The load dispatcher" was also written in answer to that suggestion or inquiry, was it not? *A* It was.

Q Did you make any investigation to determine whether or not "in practice Bristol was usually served with commingled energy generated at Falls Village, Hartford and Turners Falls in varying amounts, according to conditions, rather than to pond at Falls Village for Bristol requirements"? *A* I did not.

* * * * * * [*2208*]

AUSTIN D. BARNEY,

previously sworn, resumed his testimony:

Cross Examination (*resumed*) *by* Mr. BRANCH.

* * * * * * [*2214*]

Mr. Branch: We may be able to shorten this matter if counsel for the Commission would indicate to us his contention as to the duration of the emergency. He has stated that he makes no contention that what was done during the emergency would [*2215*] be material, or that they would base no claim on it, but he has not indicated what he regards as the extent of the emergency.

May I ask that of counsel? I believe some statement was made on that. Will you amplify that?

Mr. Wahrenbrock: Mr. Examiner, the matter is of little moment, I think, and I would be glad to do what I can to clear it up. It is already in the record, the period of time on which the witness Miller's studies of flows were made, and the period of time during which those flows occurred. They began January 1, 1937 at the earliest. I think there is no contention that that covers the emergency period at all, so I don't see why he wants to argue the emergency period at all in this case.

* * * * * * [*2218*]

Mr. Wahrenbrock: Mr. Examiner, I wish to clarify one thing. We have been discussing here the period of the emergency and the period with respect to which Mr. Miller's studies relate. I want to make it perfectly clear that nothing I have said relates to the Groton situation, with respect to the period of time that is involved.

Trial Examiner: It will be so understood. I don't think there is any intention to consider this witness's testimony in connection with Groton at all.

* * * * * * [*2227*]

Redirect Examination by Mr. WAHRENBROCK.

* * * * * * [*2231*]

By Mr. Wahrenbrock: *Q* Without reading again the question and answer, I will ask you whether by the answer you made you intended to imply that under Exhibit 39, out of State energy might not be supplied? *A* No, I didn't meant to imply any such thing under the exhibit. Exhibit No. 39 only goes to exchanges of energy between the parties thereto, and has no relationship so far as I know, never has had, to what any of the parties do with the energy thereafter. There is nothing in that exhibit that has any relationship to any supply of energy by the separate company thereto.

Q Do you mean to say that under Exhibit No. 39, electric energy is not supplied which is utilized by the companies which receive it, to satisfy the requirements laid on them by the contracts of The Connecticut Power Company with The Torrington Electric Light Company and The Connecticut Power Company at Bristol?

Mr. Branch: Excuse me. The train prevented my hearing the first part of the question. May I have it read?

Trial Examiner: The reporter will read the question for [*2232*] the benefit of respondent's counsel.

(Whereupon the last question as above recorded, was read by the reporter.)

Mr. Branch: I object to that question. I think Exhibit 39 speaks for itself, and this kind of a question is not proper to ask one's own witness.

Trial Examiner: It seems to me the question is in order. The objection is overruled and exception will be noted for the respondent.

The Witness: That is in essence an engineering question. I can't say just what The Connecticut Power Company does with the energy they may receive from the Exchange. I know as a layman that it must be utilized some way. Now, that is as far as I can go.

[*2233*] *Q* I will ask you this question, if I may, Mr. Barney: Why, when Mr. Branch asked you whether there had been any contract arrangement or understanding providing that any energy originating outside of the State of Connecticut be delivered either to The Torrington Electric Light Company or to The Connecticut Light and Power Company by The Connecticut Power Company, did you limit your response to agreements between The Connecticut Power Company and The Connecticut Light and Power Company? *A* Well, getting into the question of contractual relationships, I limited my answer in that case because I don't know of any contract between the companies that call for or in any way provide for a source of energy outside the State.

Q You did know of Exhibit 39, didn't you? *A* Yes, but as I have stated before, Exhibit 39 has no relationship to those contracts which, as far as I have been able to read them or understand them, are firm power contracts for firm capacity all located in the State of Connecticut.

Mr. Wahrenbrock: Well, I don't think I need argue the contents of an exhibit which is in the record.

No further direct and no further redirect, Mr. Examiner.

Mr. Branch: Just one or two questions, Mr. Barney.

Trial Examiner: This is in re-cross?

Mr. Branch: Yes, sir.

Recross Examination by Mr. BRANCH. [*2234*]

Q Do you know of any contract arrangement or understanding that has been in effect at any time since August 25, 1936 which provides—I should say August 26th, 1935—which provides that any energy originating outside of the State of Connecticut be delivered either to The Torrington Electric Light Company or to The Connecticut Light and Power Company by The Connecticut Power Company? *A* I think my answer is "No" but that was rather an involved question. I don't know of any contracts between The Connecticut Power Company, contract or arrangement, and any other company outside of the State, that calls for within its terms, or in any way provides the source of power under the terms of such an arrangement, for delivery of such power to The Connecticut Light and Power Company at Bristol or to The Torrington Electric Company. In other words, any contract that is an underwriting contract, similar to the contract between The Connecticut Power Company and The Hartford Electric Light Company for the supply of power to The Connecticut Power Company, covering its obligations at Bristol to The Connecticut Light and Power Company. The only arrangement I know of concerning energy outside of the State is the Connecticut Valley Power Exchange arrangement, exhibit 39.

Q And would the answer be the same answer applied to the

[2235] supply of The Connecticut Light and Power Company at the East Hampton District? *A* Yes, the same answer would apply.

* * * * * * [2245]

H. D. LARRABEE,

a witness called in behalf of the Federal Power Commission, being first duly sworn, testified as follows:

Direct Examination by Mr. WAHRENBROCK.

Q Will you state your name for the record, please? *A* H. D. Larrabee.

Q And your business address? *A* 1270 Main Street, Willimantic, Connecticut.

Q I beg your pardon? *A* 1270 Main Street, Willimantic, Connecticut.

Q And your home address? *A* Wyndham Centre, Connecticut.

[2246] *Q* What is your position with the Connecticut Light and Power Company? *A* I am manager of its Eastern Division.

Q How long have you held that position? *A* Since it was formed in 1937.

Q 1927? *A* '37.

Q How long prior to that time had you been employed by The Connecticut Light and Power Company, or a predecessor company of that company? *A* Since August 1st, 1919.

Mr. Wahrenbrock: I direct the respondent's counsel's attention to the memorandum "Re Borough of Groton," dated September 6th, 1935, photostatic copies of which they have furnished me, and I believe have retained photostatic copies, and hand one copy to the reporter and one to the Examiner, and ask that the memorandum be marked for identification as Exhibit Number 75.

Trial Examiner: It will be so marked.

(Document referred to was marked Exhibit Number 75 for Identification.)

By Mr. Wahrenbrock: *Q* I show the witness Exhibit Number

75 for Identification, and ask him if he can tell us what the memorandum was of which Exhibit 75 for Identification is a photostatic copy? *A* That is a memorandum explaining the general set-up [*2247*] of lines and facilities in the neighborhood of the Borough of Groton.

Q Was the original of that memorandum prepared and signed by you? *A* Yes, I believe so.

[*2248*] *Q* And to whom was it submitted? *A* I don't know.

Q About what time was it prepared by you? *A* Why, I presume about the time of its date, September 6, 1935.

Q I direct your attention to the sketch which is attached and ask you if that was attached to the original memorandum? *A* I think it must have been. It was prepared in connection with a memorandum.

Q Was that prepared by you or under your direction? *A* Under my direction, yes.

Q I direct your attention to the fourth paragraph of the memorandum, which reads as follows:

> "At Trails Corner we own the land upon which the transmission line and transformers are erected and, also the lines, transformers, and metering equipment."

Trial Examiner: Does the witness have the question?

The Witness: Yes.

By Mr. Wahrenbrock: I asked you if you will explain, Mr. Larrabee, what the transmission lines referred to were? *A* The lines shown on the sketch.

Q That is, it was a portion of the 33,000 volt line of the Connecticut Light and Power Company from Montville to Trails Corner substation, and from thence to the Groton-Long [*2249*] Point outdoor substation ? *A* More correctly, I think, it is the line from Hallville, a line from Hallville to the points shown on this map.

Q And by points shown on this map, you mean Trails Corner substation and Groton-Long Point outdoor substation? *A* Yes.

Q What does the legend near the top of the sketch on the transmission line, "To Montville station", mean? *A* The line is connected to the Montville station and gets its energy from the Montville station.

Q And is—or up until about March, some time in February of this year, was that energy which was received from the Montville station, was some of that energy which was received from the Montville station delivered to Fishers Island?

Mr. Branch: I think the question is by whom. I think it ought to be—

Mr. Wahrenbrock: I am not asking by whom. I am asking if energy was delivered.

Trial Examiner: I think the question is relevant. If it is desired to be further brought out, it may be brought out by counsel on either side afterwards.

By Mr. Wahrenbrock: *Q* Do you have the question in mind? *A* Yes. We did not deliver it, no.

Q That wasn't my question. My question was whether [*2250*] some of that energy was delivered to Fishers Island? *A* I don't know that I could properly say, since it goes beyond the end of our facilities.

Q But your knowledge isn't limited to the scope of the facilities in your company, is it? *A* Pretty much.

Q Well, you know some things beyond the scope of the facilities of your company? *A* Yes.

Q Actually, as a matter of fact, in this memorandum you stated where that energy went, didn't you? *A* I stated on the second page that the 6600 volt circuit mentioned supplied the submarine cables and the Borough of Groton-Long Point substation.

Q What did you mean by supplying the submarine cables? *A* That the 6600 volt circuit was connected to the submarine cable.

Q And where did the submarine cable lead? *A* Fishers Island.

Q And where did they take the energy to? *A* They take it where it went. The cable went to Fishers Island and were con-

nected to the 6600 volt line, that little substation shown down at the point.

Q Yes. Now, that submarine cable and the lines to which it was attached supplied some of the energy which The Connecticut [*2251*] Light and Power Company took to the Borough of Groton and to the Groton-Long Point—supplied some of that energy to the Fishers Island, didn't it?

Mr. Branch: May I have the question read, please?

Trial Examiner: The reporter will read the question for the benefit of counsel for the respondent.

(Whereupon the last question as above reported, was read by the reporter.)

Mr. Branch: I object to it on the ground there are several assumptions there. I don't object to a question designed to bring out what I think he is driving at, but I object to the question in that form.

[*2252*] Trial Examiner: I don't know whether the question was in very good form. Counsel seems to have made a slight error and at one point corrected it in the question, if I understand it correctly.

Mr. Wahrenbrock: May the reporter not go away until we get this question settled, please?

Trial Examiner: It might be well if the question were reframed, if the witness has any question as to what it means.

By Mr. Wahrenbrock: *Q* Was some of the electric energy which The Connecticut Light and Power Company supplied to Trails Corner and to Groton-Long Point substation, carried by the submarine cables to Fishers Island? *A* Yes.

Q And was it consumed at points on Fishers Island? *A* I couldn't say. I don't know. Presumably it was. I never have been on Fishers Island.

Q That was the purpose for taking it to Fishers Island, wasn't it? *A* I presume so, certainly.

Q I direct your attention to the seventh paragraph of this memorandum, Exhibit 75 for Identification, which reads:

"The Borough of Groton pays us an 11 per cent annual investment charge on $30,210.12, covering the transformers and substation equipment which we own at Trails Corner and at Groton- [*2253*] Long Point substation and also our investment in the second transmission circuit from the chicken farm to the Groton-Long Point substation",

and I ask you whether the statements made in that paragraph were correct, to the best of your knowledge and belief? *A* Yes, to the best of my knowledge and belief.

Q I will refer now to the next paragraph, the second sentence of the next paragraph:

"Due to uncertainties which at that time existed (referring to October 31, 1933) in regard to the use of the transmission lines beyond Trails Corner, it was not possible to promptly comply with this request",

and I ask you what the transmission lines beyond Trails Corner were, to which you referred? *A* It was that part of the 33,000 volt line which for some time previously had been used to supply energy to the Groton Iron Works and the Atlantic Coast Fisheries, and there was the uncertainty referred to there, the uncertainty as to whether or not an industry would revive at that point.

Mr. Wahrenbrock: Will the reporter read me the last part of that answer? I missed part of it.

Trial Examiner: The reporter will read the answer back for the benefit of Commission counsel.

(The answer is read by the reporter.)

By Mr. Wahrenbrock: *Q* Now, I direct your attention to the last sentence of [*2254*] that same paragraph:

"Since June 11, 1935, therefore, we have had two delivery points as before; one at the low tension terminals of the transformers at Trails Corner, and the other at the terminals of our transmission lines at the Groton-Long Point substation, with a single metering point at 33 k. v. at Trails Corner."

And I ask you what "transmission lines" to which you referred there, referred to? *A* That is the two 33 k. v. circuits on one pole line indicated diagrammatically on this sketch.

Q Mr. Larrabee, what was the purpose of the preparation of this memorandum? *A* I am not sure.

Q Have you any recollection about it? *A* I can't be sure. Somebody must have asked me what the situation was and I attempted to explain it.

Q What is your best recollection as to who that somebody was?

Mr. Branch: Well, I object to that. He says he doesn't know, and I don't think that he should be requested to go any further.

Mr. Wahrenbrock: I think I am entitled to inquire and find the extent of his recollection without interference, Mr. Examiner?

Mr. Branch: Well, I object to the question on the ground [2255] I have stated, which seems to me to be sound.

Trial Examiner: I think that he may pursue the question to the extent of his recollection. The witness may answer if he has any recollection in the matter.

Mr. Wahrenbrock: May the question be read to the witness now?

The Witness: I know what the question is.

Trial Examiner: If the witness has no recollection, he can say so.

Mr. Wahrenbrock: And may the question be read to the witness?

Trial Examiner: The question will be read to the witness.

(Question read by the reporter.)

A I think it must have been Mr. Perkins, who was at that time vice president, executive officer in charge of the Eastern Division.

By Mr. Wahrenbrock: *Q* Did you report to or were you responsible to Mr. Perkins at that time, directly? *A* Yes.

Q Do you recall what the occasion was for his making an inquiry of you? *A* I am afraid I couldn't be sure at all about that.

By Mr. Wahrenbrock: *Q* Well, what is your best recollection in that connection? *A* Rather poor, because there had so many

different things [*2256*] come up in regard to investment and equipment down there, and other matters, in relation to our supply to the Borough, it would be difficult to pick out any one thing.

[*2257*] *Q* Do you have any notes or diary or journal with you to which you can refer to refresh your recollection of these matters? *A* I have a book.

Q Can you by referring to that book refresh your recollection as to the occasion or the circumstances for your making this report or this memorandum? *A* I don't know that that helps much. There had been this question of the single metering point, among other things, brought up. The question of the extent of our ownership of facilities may have been some such thing as that.

Q I show you Exhibit 66, and ask you if, by referring to that exhibit, you can refresh your recollection as to the circumstances under which your memorandum of September 6th was requested, or prepared? *A* This would indicate perhaps that Mr. Perkins had had some discussion in regard to our delivery points. But since Mr. Perkins and I were in the same office at Norwich, it wasn't naturally customary for us to write memoranda to each other, so that any request he might have made was likely to have been verbal, and that is my reason perhaps for not being able to remember.

Q What was the district in which you were employed at that time, in September of 1935? *A* Well, the same general location that I am in now, [*2258*] except the office was at Norwich instead of Willimantic.

Q What parts of the State did that district include at that time? *A* That included the territory which we served in the eastern section of the State, starting from the Massachusetts line in the town of Thompson, and I think Woodstock, extending south.

Q I show you Exhibit 71, and ask you whether—

Trial Examiner: Is that Exhibit 71 or 71 for Identification?

Mr. Wahrenbrock: I am not sure at the moment. At any rate, Exhibit 71 for Identification will make it sure what I mean.

By Mr. Wahrenbrock: *Q* And ask you whether the district to

which you refer is substantially the shaded area at the right-hand side of the map? *A* Yes, it is.

Q And were you at that time generally familiar with the operations of the company throughout that district? *A* Yes.

Q Were you familiar with the steps taken by the company in 1935, to disconnect its State line, its lines across or near State lines up in the northeastern corner of the State?

Mr. Branch: I object to it as immaterial.

Trial Examiner: Is it established that this was subsequent to the period of the effective date of the Federal Power [*2259*] Act?

Mr. Wahrenbrock: No, sir.

Trial Examiner: It doesn't seem to me that the question is material.

Mr. Wahrenbrock: I am laying a basis, Mr. Examiner, for further questions.

Trial Examiner: What is the purpose of those further questions, before you go further?

Mr. Wahrenbrock: If the point is to be argued, may it be argued in the absence of the witness, please?

Trial Examiner: All right, if the witness will withdraw from the room until he is called.

(Witness temporarily withdrew from the room at this point.)

Mr. Wahrenbrock: Mr. Examiner, I wish to ascertain whether the memorandum which has been referred to and which was prepared by the witness was prepared by him in connection with a line of consideration by the Company or the Company's officials as to whether the Fishers Island connection would subject them to the jurisdiction of the Federal Power Commission if the Bill which was then pending, or the Act, when it had been enacted, the Federal Power Act, should be enacted. I propose to show that the Company had full knowledge of all the facts upon which jurisdiction of the Commission vested after the enactment of the Act.

Mr. Branch: Well, sir, I don't quite understand your [*2260*] position. I think that I have stated that we had full knowledge of

the situation in respect to Fishers Island and there is no need in going into that. I don't see how anything that is suggested now could do anything more than establish that fact.

Trial Examiner: It doesn't seem to me that the proof of the question as to what happened before August, 1935,—it doesn't seem to me to be material to a memorandum dated after that date. The date of the memorandum is established and is within the period of the Act and why should it be necessary to bring in matters which are irrelevant, in order to prove the date of a memorandum which has a date upon it within the Act?

Mr. Wahrenbrock: Mr. Examiner, this is some time back. I expect to refresh the witness's recollection with the efforts which were then being made, in order to ascertain whether this memorandum which he has thus far been unable to recall the occasion for making, was prepared by him in the course of the company's general efforts to cut lines which would subject it to the Commission's jurisdiction, and that the Company, knowing that these were transmission facilities, which it owned, and knowing that the energy transmitted over them went out of the State, nevertheless chose to remain the owner and the operator of those facilities and to take its chances on the Federal Power Commission's jurisdiction.

[*2261*] Trial Examiner: You can do that without going into anything that happened prior to the effective date of the Act. It seems to me if we start into material prior to the effective date of the Act we are going to get a lot of irrelevant matter into the record. What they did prior to the effective date of the Act is absolutely irrelevant.

Mr. Wahrenbrock: Mr. Examiner, men's minds don't just cut off at a stonewall on August 25 in order to establish their recollection of what happened on and after that date. You have got to go back and explore the events which led up to it.

Trial Examiner: Well, if counsel could word his question in such a way as to inquire as to whether there was anything prior to 1935, which had to do with this memorandum, that might raise

another question. I might ask what the particular purposes of showing the reasons for the memorandum are.

Mr. Wahrenbrock: To show the Company's knowledge that some of the energy which it delivered to the Borough of Groton was to its knowledge energy which was being delivered to Fishers Island and consumed on Fishers Island.

Trial Examiner: I understand counsel to say that the Company admitted that they knew that. Is that correct?

Mr. Branch: We know the facts there. I don't know whether I would put it precisely that way, about the energy, but we knew the connections and the fact that that was the only [*2262*] source of supply there to Fishers Island.

Trial Examiner: Well, does counsel admit that they knew that energy was being transmitted to Fishers Island?

Mr. Branch: Why, yes.

Mr. Wahrenbrock: But there is still the further point then it was a part of the energy which the respondent was delivering to the Borough of Groton which reached Fishers Island, and I propose to show that.

Trial Examiner: I think that is also admitted, is it not?

Mr. Branch: Yes. There might be some question as to whether you want to characterize it as "the energy" but there was no other source for that supply for Fishers Island.

Mr. Wahrenbrock: That is just the point that there might be some question that they might want to argue in their briefs, and in the absence of an adequate record, they might be able to. For that reason I wish to settle the question, if I can, by testimony by this and other witnesses.

Trial Examiner: It seems to be that we would be spending a lot of time on a very small matter, in view of this admission.

Mr. Wahrenbrock: If the Examiner please, a lot of time has been spent in the Hartford case on no larger matters.

Trial Examiner: Well, that fact is not relevant to the issue in this case.

[*2263*] Mr. Wahrenbrock: Besides the point that I have made,

Mr. Examiner, I propose to show further that the Company knew and treated the facilities as being transmission facilities, which is another question that is not such a small matter.

Mr. Branch: That matter has already been covered.

Mr. Wahrenbrock: I can well understand why respondents don't want it to be covered any more thoroughly than it has already.

Trial Examiner: It seems to me that if the respondents admit that these are transmission facilities, and admit that the energy was transmitted to Fishers Island, and that they knew it, I can see no advantage in proceeding in this matter as to what happened in Eastern Connecticut prior to August, 1935.

Mr. Wahrenbrock: If the Examiner please, his statement of what the respondent's counsel admit is broader than respondent's counsels' statement of what they admit.

Trial Examiner: I would like to have Commission's counsel reduce the statement of what they propose to prove to the shortest possible compass. It seems to me there is a little doubt on just what you do propose to prove. Will you make a further statement on that, to clarify it?

Mr. Wahrenbrock: Mr. Examiner, I will make that statement. I am going to preface the statement that I am going to make by the fact that until Mr. Larrabee came to the stand [*2264*] I didn't know who Mr. Larrabee was, except by his position in the Company. I hadn't talked to him about the evidence he was going to put on, so I don't know what his answers are going to be, but I expect to be able—I hope to be able to show by Mr. Larrabee that the Company knew in 1935, about the time what is now the Federal Power Act was under consideration by Congress, that its facilities leading to the Borough of Groton, and the Groton-Long Point substation were transmission facilities; that those facilities were facilities for the transmission of electric energy, part of which was transmitted to Fishers Island and consumed on Fishers Island.

[*2265*] Trial Examiner: Does Commission's counsel in doing that propose to enter into the question of the cutting of any line—

any of the Massachusetts lines? It seems to me that that question was the immaterial question which raised this argument originally.

Mr. Wahrenbrock: I was asking that question in order to refresh the witness's recollection with respect to the efforts which the company was then generally making to cut all of its interstate connections in order to introduce that subject to his recollection.

Trial Examiner: You referred, however, to the period which was not the date of this memorandum.

Mr. Wahrenbrock: I referred to the date immediately prior to the enactment of the Act. I asked about the year 1935, if I recall correctly.

Trial Examiner: It seems perfectly absurd to ask if the memorandum was related in any way to the question of the transfer of facilities in connection with the beginning of the operations of the Act, without going into the question of the cutting of these lines.

Mr. Wahrenbrock: Very well.

Trial Examiner: It seems to me an immaterial question.

Mr. Davis: Shall I summons Mr. Larrabee?

Trial Examiner: Yes, unless respondent's counsel had something further to say.

[*2266*] Mr. Branch: I approved of your ruling on that question.

(Witness returns to courtroom.)

By Mr. Wahrenbrock: *Q* Mr. Larrabee, do you recall whether the memorandum which has been marked for identification as Exhibit 75 may have been prepared by you in connection with a consideration of the problem of the company's disconnection of its interstate interconnections? *A* It might well have.

Q I will ask you whether in making the references—I withdraw that question, please. I direct your attention to Exhibit 66, which I believe is before you there. Do you recognize it? *A* Yes.

Trial Examiner: Memorandum dated June 21st or 24th, I can't be sure, 1935, to R. H. Knowlton.

The Witness: I have it.

By Mr. Wahrenbrock: *Q* And I refer to the next to the last line of the first paragraph, where there is a reference to the

33,000 volt transmission line at Groton-Long Point, and the last sentence of the second paragraph where there is a reference to the same 33,000 volt transmission line, and ask you whether it was the common practice among officials and employees of the company in 1935 to refer to the 33,000 volt line to the Borough of Groton and [2267] to the Groton-Long Point substation, as a transmission line? *A* I would think that we did refer to it as a transmission line, without any particular regard to its classification.

Q Were you ever criticised or instructed not to refer to it as a transmission line? *A* Not that I know of.

Q I didn't hear you? *A* Not that I know of.

Q Not that you know of? *A* No.

* * * * * * [2279]

ADRIAN V. S. LINDSLEY,

a witness called in behalf of the Federal Power Commission, being first duly sworn, testified as follows:

Direct Examination by Mr. WAHRENBROCK.

Q Will you please state your full name for the record? *A* Adrian V. S. Lindsley.

Trial Examiner: Speak just a little louder so that everybody can get it.

By Mr. Wahrenbrock: *Q* Your business address, please? *A* 250 Freight Street, Waterbury.

Q And your home address? *A* 424 Main Street, Watertown.

Q What position do you hold with The Connecticut Light and Power Company? *A* That of a vice president.

Q How long have you held that position? *A* Approximately two and a half years.

Q How long prior to that time were you with The Connecticut Light and Power Company or its predecessor company? *A* Since October, 1919.

Q Do you have Exhibit 76 for Identification on the desk before you?

[2280] *Q* Did you sign the original of which that is a copy? *A* I did.

* * * * * * [2295]

Cross Examination by Mr. BRANCH.

Q Mr. Lindsley, I hand you a copy of the opinion—this particular copy isn't signed, but I think it is either from Mr. Day or Day, Berry & Howard, addressed to Mr. Campbell, May 28, 1940, and I ask you whether that was a copy of the opinion that you saw at or about that time? [2296] *A* So far as I can recall, that is a copy. It is the substance of my memory at least.

* * * * * * [2297]

Redirect Examination by Mr. WAHRENBROCK.

* * * * * * *

Q Do you know whether the Borough of Groton electric [2298] organization, whatever the name of it is, whatever the department is, serves customers in the Town of Ledyard? *A* I understand so, yes.

Q Has The Connecticut Light and Power Company made any representation to Mr. Tiffany or to any of the Board of Commissioners under which he works with reference to the discontinuance of electric service by their organization to customers in the Town of Ledyard? *A* Not that I know of.

* * * * * * [2301]

By Mr. Wahrenbrock: *Q* Have you taken any acts, any steps, to indicate to the Borough of Groton or to any of its representatives that in order to procure a renewal of a contract or a new contract for the supply from you, they would first have to discontinue serving customers in the town of Ledyard? *A* I do not think that they were ever told that by me, [2302] because I did not know at the time counsel's letter was discussed with them that they were doing so.

Q You knew that they were serving customers in the town of Ledyard? *A* I did not at that time, to the best of my memory.

Q You knew at that time that they were serving customers on Groton-Long Point, didn't you? *A* Yes, and I assumed that that was within their franchise territory.

Q Did you assume that that was within the Borough of Groton? *A* I understood that that was within their chartered territory.

Q I asked you a different question. I asked you if you understood that that was within the Borough of Groton. Did you understand that Groton-Long Point was within the Borough of Groton? *A* I said that I knew nothing about the geographical subdivisions of the town of Groton, and I think that I stated that I didn't know there was a Borough of— What is this? Borough of Groton?

Trial Examiner: Groton-Long Point?

The Witness: Yes.

By Mr. Wahrenbrock: *Q* Now, Mr. Lindsley, we don't seem to be getting an answer [*2303*] to the question.

Mr. Branch: I think he has answered the question.

Trial Examiner: I think he has answered it. He said he didn't know there was a separate Borough of Groton—Long Point.

Mr. Wahrenbrock: I asked him if he assumed that Groton-Long Point was in the Borough of Groton.

Trial Examiner: He may answer that question.

A That the Borough of Groton-Long Point—

By Mr. Wahrenbrock: *Q* No. I asked you if you assumed that Groton-Long Point—you have heard of Groton-Long Point? *A* I have heard of Groton-Long Point.

Q You know where it is? *A* No, I can't say that I do know where it is.

Q Have you ever been there? *A* I have been down to the Hotel Griswold at Groton, the Shenoccossett Golf Club.

Q Have you ever been down to the Groton-Long Point high-voltage station that belonged formerly to The Connecticut Light and Power Company? *A* I have driven along the shore of what I understood was Groton-Long Point.

Q Have you ever been to the little so-called Groton-Long Point brick substation? *A* I think I have driven by that, yes.

[*2304*] *Q* Did you understand that that was Groton-Long Point, in that vicinity? *A* Yes.

Q Did you assume that Groton-Long Point was part of the Borough of Groton? *A* I did.

* * * * * *

Recross Examination by Mr. BRANCH.

Q Mr. Lindsley, if I understand it, no new contract has been made with the Borough of Groton since the contract expired, is that correct? *A* No formal, written agreement has been made.

Q Now, when that written agreement expired, you continued to serve the Borough of Groton, didn't you? *A* Yes.

Q And during some of that time the submarine cables were connected with Fishers Island, as you knew, isn't that true? *A* That is right.

Q I show you a letter—I think a copy of it appears in the Stipulation, but I show you what purports to be a copy of a letter dated June 14th, 1940 from you to Mr. A. N. Tiffany, [*2305*] Superintendent at Groton, Connecticut, and ask you whether that does appear to be a copy of a letter which you wrote Mr. Tiffany at about that date? *A* It does.

Q In that letter, did you say:

> "This will confirm the conversation which I had with you and Mr. Henry Gamber, treasurer of the Board, relative to a contract for the supply of electric power to the Borough to replace the contract expiring September 29th, 1940.
>
> "When the Borough is in a position to contract for a supply of electric power for resale and ultimate use entirely within the chartered territory of the Borough of Groton, we will be glad to enter into a new agreement to furnish the electrical requirements of the Borough, under the con-

ditions which we discussed and considered mutually agreeable on June 11th, 1940."

Did you write that to Mr. Tiffany? *A* Yes.

Mr. Wahrenbrock: Mr. Examiner, I object to the question.

Trial Examiner: On what ground?

Mr. Wahrenbrock: As going beyond the scope of the redirect and hence being improper re-cross.

Mr. Branch: May I state my purpose?

Trial Examiner: You may.

Mr. Branch: The inference apparently is that there is something inconsistent in the attitude of the Company. Accord- [2306] ing to Mr. Wahrenbrock's contention there are some customers served in Connecticut which the Borough has no right to serve. I don't know that that is so under the construction of the Charter, I don't know that situation well enough to say, but assuming that that is so, I want to show that the position of the Company in regard to this *ultra vires* act is not to tie up itself to a contract which might bind it and put it in an awkward position, and that that statement which he made is a fundamental statement which applies to all these things.

Trial Examiner: I think the question may very well be something that should properly have been asked on cross-examination. However, I will permit it, with the understanding that the Commission's counsel shall have the further right to question as of the direct.

Mr. Branch: Very well.

By Mr. Branch: *Q* Did you write Mr. Tiffany to that effect? *A* I did.

Q And has that been the position of your company right along? *A* It has.

Q And, as I understand it, no new contract has been made with the Borough? *A* No.

Q After the contract expired you did continue to sell [2307] the Borough, even while it was supplying Fishers Island, did you not? *A* We did.

* * * * * * [2314]

SAMUEL FERGUSON,

a witness called on behalf of the Federal Power Commission, being first duly sworn, testified as follows:

Direct Examination by Mr. WAHRENBROCK.

Q Will you state your full name for the record, please. *A* Samuel Ferguson.

Q Your home address? *A* Residence address, 851 Prospect Avenue; business address, 266 Pearl Street.

Q Hartford, Connecticut, in both cases? *A* Hartford, Connecticut.

Q What positions do you hold with The Hartford Electric Light Company? *A* President and chairman of the board.

Q What positions do you hold with The Connecticut Power Company? *A* The same positions, president and chairman of the board.

[2315] *Q* How long have you been president of The Hartford Electric Light Company? *A* I was elected president of the company in 1924, chairman of the board in 1935, and resumed the office of president along with the position of chairman in 1939.

Q How long have you been president of The Connecticut Power Company? *A* Twenty or twenty-one years. No. With the same interval as to position of chairman of the board, and not president, as in the case of the Hartford Company.

Q And what is the total period of time you have been an officer or employee of The Hartford Electric Light Company or a predecessor company thereof? *A* I have been with The Hartford Electric Light Company 28 years.

* * * * * * [2336]

Mr. Wahrenbrock: Mr. Examiner, during the recess, counsel for the respondent and the witness and the Commission counsel have been in a huddle, and from what Mr. Ferguson has told me, it appears that the arrangement of some of the materials which

are included in Exhibit 44 for Identification, as those materials appear in the Commission's files, is misleading, and in order to avoid any misleading effect from designating all of these materials which have heretofore been marked for identification in one group as Exhibit 44, it is now proposed that they be separately identified. And for that purpose, then, I am going to go through what has up to now been marked for identification as Exhibit 44, with Mr. Ferguson, and ask him to make a few statements about the several sheets, page [2337] by page, and simultaneously ask the separation of the Exhibit 44 for Identification into several parts, and separate identification of the parts.

Trial Examiner: All right.

By Mr. Wahrenbrock: *Q* Mr. Ferguson, do you have before you the reporter's copy of Exhibit 44 for Identification? *A* Yes, sir.

Q Now, beginning at the top sheet, will you state whether the following four pages, that is, in the order in which they appear, a sheet with the date October 25, 1935, and the heading "Interpretative order"; the next sheet with the date October 25, 1935, and headed "Point A—substation of the Hartford Electric Light Company"; and the next sheet with the No. 2 at the top, and the date October 25, 1935, and the first heading, "Point D"; and the next sheet which is simply a map, principally of the State of Connecticut, and certain lines drawn on it with a legend in the lower right-hand corner; and I ask you if those four sheets are the memorandum referred to in the first paragraph of the top letter of October 25, 1935? *A* They are.

Mr. Wahrenbrock: Mr. Examiner, I ask that the exhibit heretofore marked as Exhibit 44 for Identification be separated and the letter of the four sheets—

Trial Examiner: You don't have to have permission, in [2338] view of the fact that it is only marked for identification. It is not in the custody of the reporter until it is in evidence, and up to that time it is the property of the person offering it.

Mr. Wahrenbrock: All right. I then propose to separate the exhibit which has been marked for identification Exhibit No. 44. I propose to separate it, and have these first five sheets continue to be identified as Exhibit 44 for Identification.

Trial Examiner: I suggest that you make that 44-A, because the situation is that what was originally identified as 44 was never offered in evidence.

Mr. Wahrenbrock: All right. I ask that that letter and the four pages of that memorandum be marked for identification as Exhibit 44-A.

Trial Examiner: The letter and four pages of the memorandum attached, dated October 25, 1935, will be marked for identification as Exhibit 44-A.

By Mr. Wahrenbrock: I now direct your attention to the next three sheets of what was Exhibit 44 for Identification, consisting of the letter of September 27th, the sheet headed September 27, 1935, "Present situation", and the following sheet which has the number 2 and the heading "Objectives sought", and ask you whether that is the letter and the attached memoranda referred to in the first paragraph of the [2339] letter that you sent to the Commission on September 27th? *A* It is, to the best of my knowledge and belief.

Mr. Wahrenbrock: I ask that that be marked for identification as Exhibit 44-B.

Trial Examiner: That consists of three pages?

Mr. Wahrenbrock: Yes.

Trial Examiner: It will be so marked.

(The document referred to above was marked as Exhibit No. 44-A for Identification.)

(The document referred to was marked as Exhibit 44-B for Identification.)

By Mr. Wahrenbrock: *Q* Mr. Ferguson, I now direct your attention to the next two pages of what was Exhibit 44 for Identification, the first of them having the date at the bottom, October 2, 1935, and the heading at the top, "As to existence of emergency",

and the second one, a sheet of three paragraphs lettered small "a" and small "b" and small "c", and ask you what those two sheets were?

Mr. Branch: Excuse me. Which sheets are these, Mr. Wahrenbrock?

Mr. Wahrenbrock: I show you the two sheets.

The Witness: The first sheet which seems to be undated, according to my recollection—

By Mr. Wahrenbrock: [*2340*] *Q* I believe the first sheet is dated. *A* No—a, b and c.

Q Thank you. I am mistaken. I interrupted you. Will you continue? *A* Will you read which I have said?

(Whereupon the last answer as above recorded, was read by the reporter.)

The Witness: —should be attached to the second sheet which is dated October 2nd, as memorandum prepared for a conference with the chairman of the Federal Power Commission, which was held on October 3rd.

Q And was that memorandum of two pages submitted to Mr. McNinch by you? *A* It was discussed, and I believe submitted, as you advised me that they were taken from the files of the Commission.

Q Yes, and in that connection, I show you the originals of which these are photostats, in the files of the Commission. *A* They are the originals of the photostats to which I refer.

Q Thank you.

Mr. Wahrenbrock: I ask, Mr. Examiner, that the two sheets bound together be marked for identification as Exhibit 44-C.

Trial Examiner: The reporter will so mark them.

[*2341*] (The document referred to was marked as Exhibit No. 44-C for Identification.)

By Mr. Wahrenbrock: *Q* I now direct your attention, Mr. Ferguson, to the next two sheets of what was Exhibit 44, the first of which is headed September 28, 1935, memorandum, "Objections to title 2, Public Utility Act of 1935", and the second of which is

headed, "September 28, 1935, Objections to Title 2, P.U.A. 1935", and ask you what those two sheets are? *A* They are a statement of my principal objections to operating under Title 2 of the Act. My recollection is that they were prepared for internal company use, but that I also took them with me, and they were the subject of the discussion with Mr. McNinch referred to in my previous answer.

[*2342*] *Q* Did you hand them to Mr. McNinch or leave them with Mr. McNinch or some representative of the Federal Power Commission? *A* It would not have been with any representative of the Federal Power Commission, other than Mr. McNinch himself, because the conference was quite confidential on the subject, and as they appear in the files of the Commission I assume it was left with Mr. McNinch on that occasion.

Mr. Wahrenbrock: I ask that the two pages which have just been described be marked for identification as Exhibit Number 44-D.

Trial Examiner: The two pages referred to—

Mr. Branch: Are you offering something in evidence?

Trial Examiner: —will be marked for identification as Exhibit 44-D.

(Document referred to was marked Exhibit Number 44-D for Identification.)

By Mr. Wahrenbrock: *Q* Now, Mr. Ferguson, directing your attention to the last two sheets of what was Exhibit 44 for Identification, the first one being on the letterhead of The Hartford Electric Light Company under date of September 16th, 1935, the second being headed with the number "2", Federal Power Commission, September 16th, 1935, and ask you what those two sheets are. *A* They are my compliance with an order issued by the [*2343*] Federal Power Commission, order of September 11, of the Federal Power Commission.

Q And that is, the two pages together constitute a letter which you wrote to the Commission? *A* Responsive to the order of the Commission.

Mr. Wahrenbrock: I ask that those two pages bound together be marked for identification as Exhibit 44-E.

Trial Examiner: The two pages just referred to bound together will be marked as Exhibit 44-E for Identification.

(Document referred to was marked Exhibit Number 44-E for Identification.)

By Mr. Wahrenbrock: *Q* Mr. Ferguson, I now direct your attention to Exhibit 44-A for Identification, and particularly to the first paragraph, in which you state:

> "We believe all companies concerned will agree to a reconnection of their lines if the Commission would be willing to make an interpretative order."

A My personal belief.

Q I beg your pardon? *A* I thought you were through, excuse me.

Q I ask you if that was your belief. *A* That was my personal belief. I used the term "we" editorially. It was my personal belief.

Q Will you explain the bases upon which you held that [*2344*] belief, what reason you had for holding that belief?

Mr. Branch: Well, it seems to me we are getting away beyond any issue in this case, and I am going to object on the ground that it is entirely immaterial.

The Witness: The basis of my belief was—

Trial Examiner: Mr. Ferguson, there is an objection to answering the question. I admit that it is approaching a close line. However, I think it is still within the realm of proper examination and will be admitted. An excepion will be noted. *A* The belief was based on the assumption that a condition that was satisfactory prior to the cutting of the lines would also be satisfactory after the restoration of the lines, if the conditions existing prior to the cutting were restored, as far as jurisdiction of the Federal Power Commission was concerned.

By Mr. Wahrenbrock: *Q* Did you discuss the subject covered

by the attached memorandum, with any representative of The Connecticut Light and Power Company? *A* I did not.

Q Did you— *A* Unless long afterwards.

Q Did you bring it to their attention? *A* I did not.

[2345] *Q* The statements made in this memorandum attached, which is part of Exhibit 44-A for Identification, were never brought to the attention of any of the officers of The Connecticut Light and Power Company? *A* Not unless subsequent to the sending of the letter.

Q Well, were they ever, subsequently? *A* I should say probably casually, much later, but nothing to do with their preparation.

Q How much later? *A* After the proposal of working out a mutually satisfactory method of operation, with the Federal Power Commission, was definitely canned, definitely abandoned, excuse me.

Q What was the purpose of bringing it to the attention of The Connecticut Light and Power Company then? *A* Casual matter of interest.

Q Well, will you explain further why was it a matter of interest? *A* An effort I made to restore conditions, which was unsuccessful, was a matter of interest, I thought, to Mr. Campbell, and I think I told him what I had been trying to do.

Q Did you discuss it with him? *A* I have no recollection of it, but undoubtedly I talked with him about what I had been trying to do.

* * * * * * [2347]

Q At any time subsequent to October 25, 1935, has any officer or representative of The Connecticut Light and Power Company objected to the accuracy or pointed out any inaccuracy of any statement made by you in this Exhibit 44-A for Identification?

[2348] Mr. Branch: Well, I object to that. It seems to me that has no materiality. It hasn't appeared that counsel for The Connecticut Light and Power Company had any knowledge of

these things up to the time of the present hearing, and I don't understand it to be the fact.

Trial Examiner: I don't understand that the question mentions counsel. May I have the question read back?

(Question read by the reporter.)

Trial Examiner: I think the question may be answered, and call Mr. Branch's attention to the fact that counsel are not mentioned. It is an "officer or representative".

Mr. Branch: It doesn't appear, sir, that any representative of the Company saw a copy of this thing. There is no evidence whatever of that, I think. Although I got the question as just referring to counsel, it is equally applicable as to any representative.

Trial Examiner: Does counsel for the Commission desire to be heard on that point?

Mr. Wahrenbrock: I would like to have the question read again, please. I direct attention to the fact that it does not depend upon this memorandum having been shown to the respondents.

Trial Examiner: The question will be read for the benefit of Commission's counsel.

(Question read by the reporter.)

[2349] Trial Examiner: I think the witness may answer the question. *A* I have never had pointed out to me any inaccuracy. I have had comment made of talking about facilities that belonged to some other than my own company.

Trial Examiner: May I hear the last sentence of that answer?

(Last sentence of the answer is read by the reporter.)

[2350] By Mr. Wahrenbrock: *Q* Mr. Ferguson, I show you Exhibit 47 for Identification, and ask you whether—I had better show you the reporter's copy. I show you Exhibit 47 for Identification. I ask you if that is a letter with attached memorandum which you sent to Mr. Roraback on November 19, 1935? *A* I believe it is. The letter bears my signature, and I believe that the memorandum attached is the memorandum that went with the letter. And in this connection it appears that I sent—communicated with

The Connecticut Light and Power Company other than casually, prior to the giving up of the attempt to come to an agreement, as this is dated November 19th, approximately only one month after my letter of October 25th to Mr. McNinch.

Mr. Branch: May I have the answer read, please?

Trial Examiner: The answer will be read for the benefit of respondent's counsel.

(Whereupon the last answer as above recorded, was read by the reporter.)

By Mr. Wahrenbrock: *Q* Mr. Ferguson, I direct your attention to Exhibit 47 for Identification and Exhibit 44-A for Identification, and ask that you compare the memoranda which are attached respectively to those letters, and ask you this question, whether with one exception, the two memoranda are in substance identical, and [*2351*] the exception to which I refer is that on the first page of the memorandum which you sent to Mr. McNinch there are nine points under the heading, "Interpretive order", whereas on the first page of the memorandum which you sent to Mr. Roraback on November 19th, there are only eight points, the ninth one in the memorandum to the Commission being omitted from the memorandum to Mr. Roraback. The question then being whether with that exception the two memoranda are substantially —I am not asking word for word and comma for comma, but in substance the same memorandum. *A* I believe they are in substance. I haven't checked the phraseology, but the substance, with the exception of No. 9, is the same.

* * * * * * [*2352*]

Q Having written this letter of November 19th to Mr. Roraback with the memorandum therein enclosed prior to what you have referred to as the abandonment of your attempt with respect to the Federal Power Commission, did Mr. Roraback indicate to you any interest in your attempt with the Federal Power Commission. *A* He didn't know about them.

Q I refer to the period after the letter of November 19, 1935. *A* Oh, after that period?

Q Yes. *A* I had no contact with him.

* * * * * * [2353]

The Witness: I desire to correct my testimony. I have introduced a confusion here which I would like to correct.

Trial Examiner: All right, you may do so.

The Witness: This letter to Mr. Roraback has no reference whatever, although I carelessly in my previous answer assumed it had, to the efforts that I was advisedly making to reach[2354] an agreement with the Federal Power Commission. This letter to Mr. Roraback states what we propose to do after Hartford had transferred, sold all its transmission facilities to The Connecticut Power Company, and that The Connecticut Power Company restored the lines, and we asked and we stated in the memorandum to Mr. Roraback why we believed that Hartford was clear of contamination under the circumstances, and we expressed the hope that he would take the same position as Hartford did. That had nothing whatever to do with the conferences which I was confidentially, or personally anyhow, if not confidentially, carrying on previous to this with Mr. McNinch, as to the possibility of the Commission solving the difficulty by the use of the emergency section of the Act.

By Mr. Wahrenbrock: *Q* Is that also true with respect to your efforts to obtain an interpretive order from the Commission? *A* It is. The had no knowledge of my personal efforts with regard to the interpretive order, which was an effort to work out a cooperative agreement with the Commission by which the lines could be restored without making other changes. This letter refers to other changes that were made after that plan was found to be not feasible.

Q Now, when you say The Connecticut Light and Power Company had no knowledge, do you mean until after your attempt had been abandoned? [2355] *A* That is what I meant, and what I tes-

tified to previously. I was careless in reading this exhibit that you placed in my hands, in thinking that that referred to the interpretive order or discussions on the interpretive order which it does not.

Q Do I understand you to mean that The Connecticut Light and Power Company never knew of the efforts that you had made? *A* They knew of them subsequently, but not at the time. It was a personal effort on my part, and largely confidential between myself and Mr. McNinch. I assured Mr. McNinch in the conference of October 3rd, that if we saw fit to use the powers of the Commission under the emergency section, that the initiative would come from him, and we would simply obey, or not resist the orders that he might issue under them.

Q And in your communications with Mr. McNinch, you did not act upon behalf of The Connecticut Light and Power Company in any way? A In no way, shape or manner.

* * * * * * [*2356*]

Q I am directing your attention to the second paragraph—the second page of the memorandum under the heading, "Point A, substation of The Hartford Electric Light Company", there occurs this statement: "This substation", referring to the substation of The Hartford Electric Light Company, "has two functions: One, to deliver power generated by Hartford to The Connecticut Power Company. This power is eventually sold by The Connecticut Power Company, according to its business necessities, to customers both within and without the State." And I ask you if that was in your opinion a true statement? *A* I believe that that is the fact. The Hartford Company sold to The Connecticut Power Company, and it was none of our business what they did with the power.

[*2357*] *Q* And the second statement: "To refer to power purchased from The Connecticut Power Company, the power so purchased may, according to the business necessities of The Connecticut Power Company, have been generated in its own plant or purchased in whole or in part from other companies within or

without the State",—and in your opinion, was that a true statement? *A* It was. It was no business of ours where the power came from, but it was a matter of knowledge that they exchanged transactions, power was exchanged with the Massachusetts Company.

Mr. Wahrenbrock: I will have to ask to have that re-read by the reporter.

Trial Examiner: The answer will be re-read. Is the question clear in everybody's mind? Mr. Branch, do you desire the answer or also the question?

Mr. Branch: Just the answer.

Trial Examiner: The answer will be read.

(The answer is read by the reporter.)

A Before the next question—

By Mr. Wahrenbrock: *Q* Yes, indeed—? *A* (Continuing)—may I further explain the answers to the last two questions, referring to this memorandum which was a memorandum of intent for the future? It was not a memoran- [2358] dum reciting practices. It is referred to in the letter of November 19th, "It is our plan to reconnect these lines and to stand on the proposition that while such connections make The Connecticut Power Company a public utility under the Act, that all transactions in the State between The Connecticut Power Company and the other companies are intrastate and do not bring such other companies under the definition."

Then a memorandum is on the proposition that we propose to reconnect the lines and to stand on the proposition as proposed in the memorandum. It was not a recitation of facts which had been going on, although there might be.

By Mr. Wahrenbrock: *Q* Yes, because at that time, the H-A and E-lines were disconnected at the State boundary. *A* That is correct.

* * * * * * [2359]

Q I wish to direct your attention to the next heading on the same page of that memorandum which is part of Exhibit 44-A for

Identification, under the heading "Points B and B-1, substations of The Connecticut Light and Power Company", and particularly to this statement: "These are points of delivery",—and I ask you first, what are the points B and B-1 which are referred to as "These"? *A* The marks indicated on the map as B and B-1.

Q That would be the Trails—That would be the Groton Long Point substation and the Trails Corner substation of The Connecticut Light and Power Company? *A* I have no knowledge of the names.

Q Well, how would you identify those points? *A* As points on the lines of The Connecticut Light and Power Company, or the Groton Municipality, located between Montville and Groton-Long Point.

[*2360*] *Q* With that explanation then, I continue with the reading:

"These are points of delivery for power sold by The Connecticut Light and Power Company to the electric department of the Town of Groton. This power is eventually sold by Groton to its customers within the State. One of these customers, Fishers Island Farms, transmits the major portion, but not all of the power so purchased, to Fishers Island, New York." And I ask you whether that was a true statement.

Mr. Branch: Well, I object. I don't think that it appears that this witness has knowledge, personal knowledge, of those facts, and it doesn't seem to me that that is a proper way of bringing out that fact, if it is important. Certainly it isn't proper to just read one's own witness something that he stated and then say "Is that a fact?"

Trial Examiner: In view of the objection taken, I think it is advisable that Commission counsel lay a background of knowledge in asking the question.

By Mr. Wahrenbrock: *Q* Mr. Ferguson, do you have personal knowledge of how the Fishers Island electrical requirements were served at the time of this memorandum? *A* It is rather difficult to state personal knowledge. It was, I thought, a well-

known fact, that Fishers Island received its supply from Groton-Long Point. I did have personal know- [*2361*] ledge, because I once saw the contract between Fishers Island and the Municipality of Groton, but I have never seen the substrations or the facilities used.

Q What would you say was the purpose for which you put in these two paragraphs under "Points B and B-1", in your memorandum?

Mr. Branch: I object to his purpose as immaterial.

Trial Examiner: I don't think the witness's purpose is material. The objection is sustained.

By Mr. Wahrenbrock: *Q* What was the interest of The Hartford Electric Light Company or The Connecticut Power Company in obtaining from the Federal Power Commission an interpretative order with respect to facilities of The Connecticut Light and Power Company at points B and B-1 as mentioned in this memorandum?

Mr. Branch: Well, I object to it. I don't think it makes any difference what the idea was.

Trial Examiner: That may be material. The witness will answer the question. *A* It would be necessary for such an order to be of any value, to cover every point of either company's system, which might be called in question by anybody.

* * * * * * [*2364*]

Q Mr. Ferguson, I show you Exhibit 78 for Identification and ask you if that is a letter, a copy of a letter written by you? *A* I wrote such a letter and, subject to possible checking for error, I believe this is a copy of the letter I wrote Mr. Peabody as of December 5th.

Q What was the occasion of your writing such a letter? *A* A reply to his of the 4th.

Q Concerning what question? *A* The reconnection of the transmission lines which at that time were—of the interstate transmission lines which at that date were open.

Q The reconnections at the Connecticut-Massachusetts boundary of the HA lines at the New-York-Connecticut boundary of the E line? *A* At least the Connecticut-Massachusetts line. I am not sure that his referred to the other line.

Q Yes. Did the course of action which the companies you were connected with depend in part upon the action which would be taken by The Connecticut Light and Power Company? *A* We would take no action without consulting them, as they were parties to the Exchange prior to the severance of the line.

[*2365*] *Q* And at the time of writing this letter, had you consulted with The Connecticut Light and Power Company concerning its attitude toward the reconnections? *A* Yes, as shown by one of the exhibits, a letter to Mr. Roraback, under the date of November 19th.

* * * * * * [*2368*]

Q Had anyone on behalf of the Connecticut Light and Power Company, by December 5, 1935, advised you of the position [*2369*] of the Connecticut Light and Power Company, with respect to the reconnection of the Hartford-Agawam lines at the Connecticut-Massachusetts State boundary? *A* It is of course impossible to recollect as to absolute dates, but by December, 1935, I had been advised that they would not go ahead with it, would not continue to be connected, in case of reconnection.

Q Now, who had so advised you? *A* I believe it was Mr. Roraback, referring again to the so-called conference that I referred to in my previous testimony.

Q Had he, in so advising you, referred to the advice of counsel which he had obtained? *A* I believe he did do so.

Q And did he state to you what that advice was? *A* I have found in my files a copy of counsel's opinion, which my presumption is, but not my definite recollection, that it was handed to me at that time. Later, of course, the value of that opinion was somewhat clouded by the fact that it was based on the Act as originally introduced and not as finally passed.

* * * * * * [2370]

Q Mr. Ferguson, will you explain who Mr. Peabody was? *A* He was a member of the firm of Peabody, Brown, Rowley and Storey, Boston lawyers and attorneys for the Turners Falls [2371] Company.

* * * * * * [2374]

Q Mr. Ferguson, by December 5, 1935, what had Mr. Roraback advised you was the advice of counsel of The Connecticut Light and Power Company with respect to the reconnection—the maintenance of its connections with the Connecticut Power lines in the event of the reconnection of the Hartford-Agawam line?

Mr. Branch: I have no objection to that form of question, assuming it also means if any advise were given, other than my general objection to this line of inquiry. I think it ought to appear, though, whether Mr. Roraback had made any statement.

Trial Examiner: I think the witness can take care of that [2375] in his answer?

Mr. Wahrenbrock: That already appears in the testimony, and inasmuch as it does appear, I don't see any occasion for the interruption.

Trial Examiner: The witness may proceed and answer the question.

The Witness: I thought I had answered that question previously. At the time of the so-called conference, when we received an answer in the negative to their continuing connection to the Connecticut Power lines, in case of reconnection. I also stated that I thought because I subsequently found an opinion of counsel in my files, that that was given to me at that time. My recollection is that the reason for disinclination to connect was the chance that they would be interpreted thereby to be in interstate commerce, or under the jurisdiction of the Federal Power Commission, which would involve them in proceedings and lawsuits.

* * * * * *

Q Mr. Ferguson, is your present recollection on that subject

based upon this legal opinion from Mr. Thoms, to which [2376] you have referred? *A* Largely.

Q That was found subsequently? *A* It was found subsequently, and I know of no way of having received that unless it was given to me at the so-called conference when we received the negative answer to our suggestion.

Q Yes. Now, can you by referring to Exhibit No. 78 for Identification, refresh your recollection as to what your knowledge of Mr. Roraback's advice to you, what your knowledge was as of December 5, 1935? *A* Simply a refusal on the grounds of possible contamination.

Q I don't believe I make my question clear. I want to know whether you can refresh your recollection now by looking at this Exhibit No. 78 for Identification, as to what your knowledge was on the 5th of December, 1935? *A* It doesn't bring back anything.

Q You are unable to state then what you knew on December 5, 1935 of Mr. Roraback's statements to you concerning the advice of his counsel? *A.* I have stated my recollection, of a refusal on the ground of, I stated, of an assertion of jurisdiction by the Federal Power Commission, or possibly assertion of jurisdiction by the Federal Power Commission, and that at the same time I [2377] was given an opinion of counsel with reference to the matter.

* * * * * * [2378]

Q Mr. Ferguson, isn't it a fact that by December 5, 1935, Mr. Roraback had advised you that the counsel of The Connecticut Light and Power Company had advised that company, or had advised him, that there was serious danger of all transmission lines connecting with those of The Connecticut Power Company being adjudicated as facilities under the control of the Federal Power Commission?

Mr. Branch: Mr. Examiner, I think that is just a question that has been objected to throughout, and I think you ruled it is improper. The witness has stated—

Trial Examiner: It is improper on direct examination. There is a proper procedure if counsel has any question.

Mr. Wahrenbrock: Mr. Examiner, I point out that I have [2379] laid the basis to probe the witness's recollection, and I think that a sufficient basis has now been laid for such a question to be asked.

* * * * * * [2381]

Trial Examiner: To the extent that the statements may be contradictory, the question will be permitted.

Mr. Wahrenbrock: May the question be read, please?

Trial Examiner: The reporter will read the question to the witness.

(Whereupon the last question as above recorded, was read by the reporter.)

The Witness: I do not recall that Mr. Rorabock ever told me that his negative answer to our suggestion was on advice of counsel. I naturally assumed it was on advice of counsel, when I found the opinion of counsel, which I have referred to, was an erroneous opinion because it was based on the Act as introduced, instead of the Act as passed.

* * * * * * [2386]

Mr. Wahrenbrock: I offer Exhibit 44-A for identification, in evidence.

Mr. Branch: I would like to examine it. I object on the ground that it is immaterial, it not appearing that this document ever came to the attention of any representative of The Connecticut Light and Power Company, or even if it did, of having any bearing in the case.

* * * * * * [2388]

Trial Examiner: It appears to the Trial Examiner that this matter may well be said to have some relevance to the [2389] case at issue. This is not a matter before a jury where there is liable to be a confusion as to the two exhibits or proposed ex-

hibits, and the Trial Examiner rules that the exhibit now marked No. 44-A for Identification is admitted, and an exception will be noted for the respondent.

(Exhibit 44-A for Identification received in evidence as Exhibit 44-A.)

* * * * * * [2395]

Cross Examination by Mr. BRANCH.

Q Mr. Ferguson, I think you testified that you wrote a letter to Mr. Peabody, and made in it a statement as to what the Connecticut Light and Power counsel had advised. Do you recall making such a statement? *A* I recall the letter was under discussion.

Q Now, in that letter to Mr. Peabody, were you doing anything more than to state your understanding of the meaning of an opinion from Mr. Thoms, a copy of which had been sent to you? *A* I believe I stated previously that I received a negative answer to our proposal, and I thought that at the same time I received an opinion of counsel on the matter, and in my letter to Mr. Peabody I used the words that they had been advised by counsel, which was an inference on my part, rather than a fact of knowledge on my part.

Q Well, in your discussion of what counsel had advised them, were you doing anything more than giving a statement of your understanding of the substance or reasoning of that opinion [2396] from Mr. Thoms? *A* My statement to Mr. Peabody was derived from my reading of Mr. Thoms' opinion.

Q Entirely? *A* Entirely.

Q I think you have stated, Mr. Ferguson, that your best recollection was that Mr. Roraback, and possibly some other representatives of The Connecticut Light and Power Company, advised you of their determination not to connect. Do you recall? *A* I recall that.

Q Now, was Mr. C. L. Campbell present at that time, according to your best recollection? *A* I do not recall that he was or

was not. My recollection of the attendance is rather hazy, and I would not like to take oath either as to his presence or his absence. I would not have expected him to be there.

Q And have you any recollection of talking with Mr. Campbell about this matter of The Connecticut Light and Power Company's disconnecting during that fall? *A* No, sir.

* * * * * * [*2400*]

CALVIN T. HUGHES,

a witness previously sworn, resumed his testimony:

Direct Examination (*Continued*) *by* Mr. WAHRENBROCK.

* * * * * *

[*2401*] *Q* When was the decision reached to supply the East Hampton-Leesville-Colchester District by a line from Columbia? *A* Well, it would be late in '38 that the final decision was made.

Q I didn't hear you. *A* It would be some time in the Fall of '38, I believe. But it was anticipated in '36.

Q When you say "It was anticipated", what do you mean by that? *A* Well, in negotiating the contract for the supply of the East Hampton District by The Connecticut Power Company in 1936, I believe it had a provision in it that at any time after December 31st, 1939, The Connecticut Light and Power Company could take that load over and supply it from its own system. That is substantially right. I don't know whether those documents are in evidence or not, but that is reasonably right.

Q That is to say, at the time the contract for the supply of that district by The Connecticut Power Company at Pole 110 was negotiated in 1936, it was contemplated by The Connecticut Light and Power Company that it would subsequently serve that district from its own sources? *A* That is correct.

Q And that contract was made to run for a shorter period of time, or to be terminable on notice, in order that [*2402*] that might be done? *A* That is correct, and I believe it was to end December 31st, 1938 or January 1, 1939, because, I recall that we

made temporary arrangements from the first of the year until June 30th because we didn't get the facilities built to take it over.

[*2403*] Mr. Wahrenbrock: If I may have just a moment until we can locate Exhibit 25.

By Mr. Wahrenbrock: *Q* I call your attention to Exhibit 25, which is the agreement of December 16, 1936, between The Connecticut Power Company and The Connecticut Light and Power Company, whereby the Connecticut Power Company agreed to supply electric energy for the East Hampton section of The Connecticut Light and Power Company, and direct your attention to the term of that agreement as fixed in article 5, and ask you whether that is the provision to which you had reference? *A* That is what I had in mind.

Q Who owned the meter at pole 110? *A* I believe it was the Connecticut Power, but I wouldn't be too certain of that. I am under that impression, that it belonged to the Connecticut Power. I wouldn't be too sure of that, though.

Q I wish to refer now to the Bristol substation of The Connecticut Light and Power Company, and to the matter of the operating instructions under which the operator of that station operates the controls for the oil circuit breakers on the CP1 and CP2 lines at Tower 474, and wish to ask you why the operator of The Connecticut Light and Power Company's substation follows the instructions concerning which Mr. Colvin has testified in this hearing? [*2404*] *A* That—I presume you want to know the circumstances surrounding our operators performing that function.

Q Yes, what instructions he has from you to obey those instructions? *A* I wouldn't say there isn't specific instructions, because there may have been. I will just try to outline it as it comes to my mind, without too much maybe written matter to go by. I haven't anything written. That situation as I first became acquainted with it was along in 1928 or 1929—1928, I believe. And then, I think since inception of that service in Bristol, the Bristol operators had done that sort of thing as a courtesy to a

neighbor or a friend or a person whom they had been doing business with. It is purely from the point of view of giving better service. It might be incident to some delay, if it was handled some other way. Just how much, I never made a study of, and as a matter of fact, we never gave it much thought, and I am pretty sure that in years past some of our operating people—I mean that are close to the operating—maybe met with some of the Connecticut Power people and discussed the things as indicated in a letter, I believe, that was put in evidence here, or was referred to yesterday, as some instructions by Mr. Whiting. Aside from that general courtesy point of view, I know of no other reason for it. It is something we never gave any particular attention to. It doesn't amount to anything so far [*2405*] as we are concerned, and for that reason we haven't given it any particular attention.

Q Is it a matter which has been done without the knowledge of the officials of the company? *A* I can't say that, that it is without the knowledge; I believe probably some of the operating people knew about it.

Q You had known about it? *A* I knew that they performed that function, yes.

Q You never issued any instructions that they were not to do it? *A* No. No.

Q Or no fault was ever found with the operators at Bristol for following those instructions? *A* No.

Q As a matter of fact, if they hadn't followed them, fault might have been found with them? *A* I don't think so. I don't believe that we particularly accepted responsibility for the action at all, because whatever switching was done there was entirely under the responsibility of the Connecticut Power Company people, without either approving or disapproving it. We knew it was being done, and we made no effort to either approve or disapprove it. I will put it that way.

Q What is the nominal voltage at which the synchronous condensers of the Connecticut Light and Power Company at Bristol

[2406] operate? *A* I believe 13,800, or 900. I just don't recall exactly, but I think it is 13,800 or 900—I believe it is 13,800.

* * * * * * [2459]

DR. JOSEPH SLEPIAN,

a witness called on behalf of the respondent, being first duly sworn, testified as follows:

Direct Examination by Mr. BRANCH.

Q Will you please give your name? *A* Joseph Slepian.

Q Your address? *A* Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

Q What is your profession, Dr. Slepian? *A* Research engineer.

Q With what concern are you connected? *A* I am employed by the Westinghouse Electric and Manufacturing Company.

Q Will you please outline your education or preparation? *A* I received an A.B. degree at Harvard in 1911, an A.M. in 1912, Ph.D. in 1913 in Mathematics. I studied in Goettingen, Germany, and Paris, France, in 1913 and '14 in the fields of mathematics and physics. I taught mathematics at Cornell in 1914 and '15, and then I entered the employ of the Westinghouse [2460] Company.

Q Have you been with the Westinghouse Company ever since? *A.* Yes.

Q Will you outline your work, particularly in the electromagnetic field, since you have been with Westinghouse Company? *A* I worked for about a year in the shops, constructing various types of electrical power apparatus, and then have been in the research department ever since then. The first years were assisting in the making of tests of electrical apparatus and calculations on electrical systems. I became consulting research engineer after a year or two there and was engaged in consultation by the various departments of the Westinghouse Company, and then also in frequent consultation with utilities on questions relating to the operating of power systems. I was engaged in research and development of various types of power apparatus. I have made—

* * * * * *

A (Continuing) I have made numerous inventions, four or five of them are concerned with apparatus which are important items of manufacture by the Westinghouse Company. I became Associate Director of Research some three years ago and have [*2461*] held that position since then. I have written some forty or fifty technical papers, most of them published in the Transaction of the American Institute of Electrical Engineers. Some may be interpreted as bearing directly on the subject of my testimony here. I have written a book on "Conduction in Gases". I received the John Scott Medal of the Franklin Institute some years ago for work in conduction in gases. I have received one or two prizes from the American Institute of Electrical Engineers in relation to papers. I am a member of the American Academy of Sciences, a member of the corresponding body in France. I am a Fellow of the American Institute of Electrical Engineers, Fellow of the American Physical Society, a member of the American Mathematical Society, a member of the American Electro-Chemical Society.

Q Will you give a brief description of some of your inventions in the electro-magnetic field? [*2462*] *A* I invented the audio valve lightning arrester in 1920. This is an apparatus which is manufactured and sold by the Westinghouse Company for the protection of power systems and transmission distribution lines. I invented the Deion air circuit-breaker, the Deion oil circuit-breaker.

Q Is that spelled D-e-i-o-n? *A* Yes.

Q Will you continue? *A* These are all apparatus used in operating power systems. I invented the ignition mercury arc rectifier which is widely used for the conversion of alternating current into direct current for railway and chemical and electrical industries.

Q To what have you devoted yourself chiefly since you have been with the Westinghouse Company? *A* To technical problems relating to generation, distribution and the utilization of electrical power.

Q Have you seen line diagrams showing the facilities of the Connecticut Power Company at South Meadow station? *A* Yes.

Q Have you also examined diagrams showing the so-called Hartford-Agawam lines, the Connecticut Power lines, sometimes known as the CP1 and CP2 lines and the line sometimes known as the E line, that being the line which goes to the New York [*2463*] State line? *A* Yes.

Q Have you read those parts of the testimony of Mr. Harold Miller in the pending case which describes his method for preparing exhibits 61 and 62, and have you examined Exhibits 61 and 62, of which I now show you copies? *A* Yes, I have.

Q And have you also examined the facilities in the South Meadow substation in Hartford? *A* Yes, I have.

Q If electrical energy generated from two different sources is connected or is put on a common conductor which goes to a load, is it possible to determine which source supplies the load?

* * * * * *

The Witness: If each source is generating enough power to supply the load, then it is not possible to determine.

* * * * * * [*2465*]

Q Do you understand the nature and location of the metering devices which are in use at the South Meadow substation of the Connecticut Power Company at Hartford, confining it to the present? *A* Yes.

* * * * * * [*2467*]

Q Have you been at the South Meadow substation of the Connecticut Power Company? *A* Yes, I have.

Trial Examiner: I think possibly that may not go far enough. I think the statement should also show that he is familiar.

By Mr. Branch: *Q* Have you familiarized yourself with the nature and location of the metering devices, particularly the watthour meters in the South Meadow substation of the Connecticut Power Company at Hartford? *A* Yes, as far as it is possible by direct inspection and by asking the employees there.

* * * * * * [2468]

Q Will you describe in a general way as to what you know as to the location of the watt-hour meters in the substation of the Connecticut Power Company at Hartford? *A* It is a 66 kilo-volt line. It comes in over a bus structure. The connection is dropped down from the 66 kilo-volt line to instrument transformers which go to meters located in the control room of the station. The 110 kilo-volt line [2469] comes down to a transformer at the side of the bus structure and—

* * * * * *

A There is a corresponding arrangement made for metering the 110 kilo-volt lines, as I recall the construction. The power from the low-tension 11 k. v., I believe it is, comes into the station and goes to meters through appropriate transformers inside the station. The meters themselves being on the control board.

The outgoing 66 kilo-volt line, two circuits, similar arrangements are made for metering, lines are dropped from the high-tension lines down to instrument transformers and connections from the instrument transformers go to the substation to meters again on the control board.

* * * * * * [2470]

Q Are there ratchet watt-hour meters in the South Meadow substation? *A* Yes. The watt-meters I saw on the board were ratchet watt-meters.

Q Will you explain in a general way where there are watt-meters which would show anything in relation to the flow on the C-3 line, the lines going from this bus which is labeled 11 k. v. bus, and the lines further to the left, that is, to [2471] the west? *A* This diagram shows two 66 k.v. lines coming in from Massachusetts to the bus at the station. What I saw was 1 66 k. v. line and 1 110 k. v. line coming in. The watt-meters would be located in each of these lines, one now being a 66 k. v. line. Of course, that information I got by inquiry from the employee who showed me the station.

On the other bus, 66 k. v. line, I was told that the watt-meters which I saw on the board were connected to transformers which were connected to the 66 k. v. lines out in the bus structure.

The 15 k. v. lines the meters on the 15 k. v. circuit, I was told—

Mr. Branch: You said 15 k. v.

The Witness: 11 k. v., pardon me. And the 11 k. v. system, I was told, were in the lines coming from the 11 k. v. transformers in the station.

By Mr. Branch: *Q* Well, assuming then that there were at all times here ratchet meters showing flow in either direction, on all of the points you have indicated, and also on the lines going west, will you answer the questions which I now ask you?

Mr. Wahrenbrock: Mr. Examiner, I object to the assumption as put. This is not proved yet. It is based upon statements.

[*2472*] Trial Examiner: Well, can't you put a hypothetical question without including an assumption in it? It seems to me that if what you are attempting to arrive at is a hypothetical question to Dr. Slepian, an expert, it can be done without reference to any assumption of a particular state of facts having existed over a particular time.

Mr. Branch: Well, sir, may I say this: All of the testimony of Mr. Miller, I think, and also Mr. Thomas, was based on the same assumption. I don't see why I haven't the same right to go ahead on the assumptions that they went ahead on. There was no specific testimony that I recall in their testimony as to that, other than this in the testimony of Mr. Miller, I believe, which I will ask the witness to consider. I am giving this in substance, and not word for word. This is on page 1147, speaking of the Hartford-Agawam lines at the South Meadow station:

> "Two meters are placed on each line, so arranged by means of mechanical ratchets that one will integrate the flow in one direction, but whose register will not operate when the flow is reversed. The other meter will integrate the energy flow in the direction opposite to that causing the first to register and will not register while the first is registering.

"In case of the Hartford-Agawam line, one meter integrates the flow from Massachusetts to Connecticut and the other meter integrates the flow from Connecticut to Massachusetts."

[2473] He also says:

"A ratchet meter for each direction of flow is provided for each of the three lines connecting the Hartford Electric Light Company to the South Meadow substation. Separate ratchet meters for each direction of flow were provided to show the flow of energy between the South Meadow substation and the C.P. 1 and C.P. 2 lines. All of these meters were read hourly and the readings recorded in a station log sheet by an employee."

I will ask you to assume that there were ratchet meters in the locations which he described, and which recorded flow in each direction. Is that clear to you, sir? *A* Yes, it is.

Q Is that substantially the situation which you found to exist at the present time? *A* Subject to the change of one line from 66 k.v. to 110 k.v.

Q Assuming that to be the situation, during any period in which generators in Connecticut electrically connected with Bristol generated more than the load at Bristol, is it in your opinion possible to show conclusively that Bristol was supplied with any energy generated outside of Connecticut? *A* In my opinion, no.

Q Will you explain? *A* It is not possible by any physical means to distinguish [2474] electrical energy as to source. There is complete lack of identifiable individuality to electrical energy, so that there is absolutely no physical test which can be made which will determine that the energy received at Bristol is the same as that generated in Massachusetts or any other point. If the energy generation at Hartford is more than sufficient to supply the load at Bristol, one may allocate this energy generated at Hartford to the load at Bristol without in any way violating any of the principles underlying electrical engineering.

Q Would your answer be the same if readings made from ratcheted watt-meters, showing the direction and extent of flow in each direction in the lines at the South Meadow substation indicated that there was no flow from the Hartford steam plant to The Connecticut Power lines during the period in question? *A* My answer is the same.

Q Will you explain? *A* In making that answer, I recognize that the interpretation of the readings of watt-hour meters and ratchet watt-hour meters as indicating actual energy flows and lines is a postulate or hypothesis, the validity of which is substantiated only by the fact that this postulate leads to correct totals when all the electric energy generated at a given plant or consumed at a given load is computed.

[2475] Other energy flows may be postulated which equally well satisfy this condition. We may postulate that energy flows from the Hartford plant to Bristol and provided we make other energy flows in the same system take care of the other generation in other loads, there will be no contradiction with any physically verifiable fact.

* * * * * * [2476]

Q At any time in which a load or loads of The Connecticut Light and Power Company on the CP lines No. 1 and No. 2, aggregate a smaller number of kilowatt hours than the total amount of kilowatt hours generated at plants in Connecticut electrically connected with those loads, is it possible to demonstrate that any of the loads were supplied in whole or in part by energy from outside of Connecticut?

Mr. Wahrenbrock: Mr. Examiner, I object to that question. No basis whatever has been laid to show the witness's knowledge of these loads of the Connecticut Light and Power Company connected to the CP1 and CP2 lines.

Mr. Branch: Well, it is a general question.

Trial Examiner: I think it is sufficiently general that the witness may answer.

The Witness: No, it is not possible by any physically verifiable means. This is so regardless of whether generators in Massachusetts connected with the lines are or are not supplying power, and this is so regardless of the watt-hour meter readings in lines coming to and from the South Meadow bus.

By Mr. Branch: *Q* You have said in effect that it is impossible to verify such conclusions by any physical means. Are there any other means of demonstrating this which you would regard as [*2477*] scientifically satisfactory? *A* It would certainly not be satisfactory to me.

Q Is it a matter of common and accepted engineering practice to detect the flow of electrical energy between a source of supply and a load? *A* The flow of current in the line may be detected and measured. We may also detect and measure the difference of potential between the line and the ground. We may use instruments called watt meters to measure the average product of these two directly observable quantities. We may call the readings of this instrument or product an energy flow, but in doing this last we are making an hypothesis which is purely hypothesis, and has no further physical basis. When properly used, this hypothesis leads to correct results, and in the usual operation of power systems, this hypothesis is correctly used. When this hypothesis is used to determine source of energy consumed at a given load, this hypothesis is being used incorrectly, but so far as I know such use of this hypothesis is not made customarily in the operation of power systems.

Q Now, I am going to read you a statement and ask you whether you agree with it. This comes from the testimony of Mr. Thomas, volume 10, on page 1286:

> "Where electric currents or electric energy coming from two sources enter a conductor at a certain point and traverse the conductor to some further point, the usual working concept or [*2478*] hypothesis is that the two currents mix and commingle in an intimate way, and that any portions of the

mixed current drawn off from the conductor at various later points will have about the same proportions of the two component currents as was contained at the point of mixing. This is not based on tagging individual current flows, but on the common fact analogy with the mixing of streams of any kind in a long and narrow passage."

Do you agree with that statement?

Mr. Wahrenbrock: Mr. Examiner, may I pause to make a slight interjection here? "Common fact analogy" is obviously a typographical error, for it should be "common sense analogy".

Mr. Branch: I will correct it. Did I read it correctly?

Mr. Wahrenbrock: Yes, but I think that is obviously a mistake.

Mr. Branch: I will change the last sentence to read: "This is not based on tagging individual current flows, but on the common sense analogy with the mixing of streams of any kind in a long and narrow passage." Now, I am asking you whether you agree with the whole statement which consisted not only of the sentence which I have just repeated, but the other longer sentence. *A* So far as I can give any meaning to the statement, I do not agree with it.

Q Will you explain? [*2479*] *A* To begin with, this statement begins with flow of energy from generators, and then concludes with the discussion of flow of current. Now, electrical energy is not identical with electrical current. It is clear that the statement begins with one electrical quantity and becomes diverted into another electrical quantity, with some resulting confusion—to me, at least.

Q In your opinion, is there any scientific basis for concluding that if two generating plants are connected with an electric system the loads that are also connected with this system receive electrical energy from the two sources in the same proportion as the proportions of generation? *A* No. There is no possibility of determining the origin of any part of the energy received by any particular load.

Q Is it known what happens to electric energy which is generated by two separate generators attached to the same electrical system? *A* Yes. That energy will be consumed at loads somewheres.

Q Is anything more known as to what happens to the energy from the two sources in the meantime? *A* In my opinion, nothing is known, and my opinion is that no answer will be found.

Q Is it a recognized principle in electrical engineer- [*2480*] ing that neither current nor energy can flow physically in both directions in the same conductor at the same time? *A* I answer that question no, but would want to add some discussion to clarify the matter.

Q Will you clarify your answer? *A* Concerning the flow of current in opposite directions in a conductor, if it is meant a practical conductor of finite section, then I can say that there practically always is current flowing in opposite directions simultaneously. In the passage of alternating current through a conductor, as in a practical transmission line, the current flowing in the center of a conductor is slightly out of phase with the current flowing near the surface so that each cycle the current in the center will be flowing in the opposite direction to the current outside.

Q In ordinary electric systems, such as that of which the CP lines 1 and 2 are a part, is alternating current used? *A* Yes. Alternating current is the current commonly used in electrical power systems.

Q Will you continue with your explanation from where I interrupted you. *A* Now, if we ask as to the current flow in a conductor of extremely small section, or what comes to the same thing, the current flow in an infinitesimal part of a large conductor, I would say that there is a single net or total current having [*2481*] a unique direction which can be detected and measured. However, it is common practice for various purposes to regard such single current as made up of component currents and these component currents may flow in opposite directions. I can give many examples of such practice.

Q Will you give such examples. *A* In the usual treatment of transformers, it is common to regard—

* * * * * *

The Witness: In the usual treatment of transformers, it is common to regard the current flowing in the primary winding as made up of two parts—the exciting current or the current that would flow in the primary if the secondary were open-circuited and the load current or the additional current which flows in the primary in virtue of load being connected to secondary. These two components into which the primary current is resolved are usually out of phase so that part of each cycle they are flowing in opposite directions.

Another example is the common resolution of the current flowing in a conductor into a portion which is in phase with the voltage and a portion or component which is 90 degrees out of phase with the voltage. Again we have with this resolution into components the two components flowing in opposite directions [*2482*] twice per cycle. In dealing with waves on transmission lines it is common practice to regard the actual state of the transmission line as due to the simultaneous flowing of waves in both directions. The currents accompanying these waves are generally flowing in opposite directions at the same points in conductors.

In the armatures of rotary converters commonly used for supplying street railway systems the current in the coils is commonly resolved into so-called direct current and alternating current components and these currents against will flow in opposite directions a good deal of the time. So much for current flow.

Q Will you now explain your answer as respect to the possibility of energy flowing physically in both directions in the same conductor at the same time? *A* I have to begin by denying any physical meaning to the energy flow in conductors. The energy flow in the conductor is a pure postulate unverifiable by any physical means—a postulate that has utility in that it leads to the correct answers to certain types of questions. A common form of

energy flow postulate is that the energy flowing in the conductor is given by watt-meter reading connected to that conductor. However, many other perfectly valid postulate as to energy flowing in the conductor which will give physically verifiable results for any situation for which an [*2483*] answer are possible. There is therefore absolutely no reason why simultaneous energy flowing in opposite directions may not be postulated at the conductor provided the total system of flow postulated meets the condition, which I believe I have stated before, of correctly giving the total energy consumed at each load and the total energy generated at each generating station. There is no principle in physics or electrical engineering which will limit the flow we may postulate other than the one I have stated and therefore we may freely use postulated flows going simultaneously in opposite directions in a conductor if we so choose.

Q Can you give any example of energy flowing simultaneously in the same conductor in the same direction? *A* As I have said, the energy flow is purely postulate. I can set up—

Q Excuse me just a minute. I may have made a mistake.

* * * * * *

Mr. Branch: I should have said in opposite directions.

The Witness: As I have said, the energy flow is purely postulate. I can set up electrical systems, which I can proceed to do now. Let us suppose we have a generator A at one end of a line and a generator B at the other end of the line. Let us say we have load C near the first end of the line and [*2484*] load D near the second end of the line. For definiteness, let us say that each generator is generating 10,000 kilowatts and each load is consuming 10,000 kilowatts. Now, I may choose to say there is an energy flow from generator A to load D of 10,000 kilowatts along the line and at the same time an energy flow of 10,000 kilowatts from generator B to load C along the line. This description of energy flow is entirely compatible with the only verifiable or observable fact that A and B are each generating 10,000 kilowatts—C and D

are each consuming 10,000 kilowatts. This hypothesis that generator A is supplying the load D by energy flow along the line and generator B is supplying load C by energy flowing along the line requires that energy flow simultaneously in opposite directions along the line, but such implication in no way contradicts any principle of electrical engineering or any observable fact. It is, therefore, a valid hypothesis to assume such a flow exists. I can give another example.

If we will consider the reactive volt amperes which may be regarded as a kind of energy flow similar to the average volt ampere reading of a watt-meter, it is sometimes practice to place in the line simultaneously a watt-meter, and a reactive volt ampere meter. The watt-meter reading, according to the frequently used hypothesis indicates an energy flow in one direction. We may have simultaneously reactive volt amperes indicating some kind of energy flow in either [*2485*] direction, so that one of these directions might be said to be opposite to that of watt-meter indication.

Q Is there anything in the views which you have expressed, or the views which you have postulated, not only in answer to this last question, but in answer to the rest of your questions, which would invalidate the results that are commonly obtained in commercial practice from the use of watt-hour meters? *A* So far as I know, no.

Q As far as you know, has there ever been occasion, except possibly in connection with investigations of the Federal Power Commission in recent years, to attempt to trace the flow of energy from different sources to a load where two generating plants are connected with the same electrical system? *A* No.

Q It has been suggested that the current flow in a conductor might be considered to consist of the simultaneous flow of two or more components in opposite directions. If this were so, would not the loss occurring in the line be considerably greater than the loss actually observed? *A* No. The heating of the conductor is determined by the total or net current flowing in it and is not

affected by the number of components in which you choose to resolve your actual net current.

Q What have you to say as to the following explanation [*2486*] of the contention that current cannot flow in a single circuit in both directions simultaneously? I quote: "For example, if we had one ampere going one way in a circuit and 2 amperes going the other way, if you can imagine such a thing, we would at least have the energy loss in resistance in one, due the current of 1 and energy lost in that same conductor due to the flow of the other, due to the current of 2, making a total, we will say of 5, whereas the actual fact occurs"—that should be 3 instead of 5—"whereas the actual fact occurs that we have only the different"—the energy loss of 1. "That would be a physical thing you can measure, and by experience you would know that the loss you measured couldn't be due to two currents flowing at the same time in the same wire."

* * * * * * [*2487*]

Q Mr. Slepian, I am going to ask you to follow this statement, and then comment upon it. The statement was given as an explanation in support of the contention that current [*2488*] cannot flow in a single conductor in both directions simultaneously.

This is the statement:

> "If we had one ampere going one way in a circuit and two amperes going the other way, if you can imagine such a thing, we would at least have the energy loss in resistance in one due to the current of one and energy loss in that same conductor due to the flow of the other, due to the current of two, making a total, we will say, of five, whereas the actual fact occurs we have only the difference flowing of one and the energy loss of one. That would be a physical thing you can measure, and by experience you would know that the loss you measured couldn't be due to two currents flowing at the same time in the same wire."

First of all, do you understand that statement?

Trial Examiner: Do I understand that one and two and five?

Mr. Branch: I asked Mr. Thomas through Mr. Wahrenbrock if he would make any corrections, and as that was not changed, I understand that it is correct.

Mr. Wahrenbrock: I have indicated to you two corrections and I think you gave effect to them in your reading.

Trial Examiner: All right.

By Mr. Branch: *Q* Mr. Slepian, what have you to say as to that explanation [*2489*] of that contention? *A* There is no reason why the heating effect of two currents flowing simultaneously in the conductor should be the sum of the heating effects which would be produced if each current flowed by itself. Therefore, there is no contradiction if the heating effect of two currents flowing simultaneously is less than the sum of the heating effect which each would produce individually. The actual heating effect will always be determined by the total or net current and the losses in the transmission line are due to this heating effect almost entirely.

Q Will you give a further explanation of your view that usage of watt-meter readings as indications of energy flow in conductors is a postulate which cannot conclusively determine the origin of electrical energy for any particular load? *A* Well, you can easily create situations where the use of such postulate will lead to obviously ridiculous results. For example, we may make an electrical system where watt-meters will indicate more energy than is being supplied to the system. Consider a transformer with one terminal grounded and the other terminal at 10,000 volts. If one ampere flows in this terminal line and at 100 per cent power factor, a watt-meter placed in this line will indicate 10,000 watts.

[*2490*] Suppose that this transformer has a tap which is 9,900 volts above ground or 100 volts from the high end of the transformer, and suppose a line to come from this tap. If one ampere flows from this line, a watt-meter placed in the line will indicate plus or minus 9,900 watts, depending upon the direction of the current.

Suppose now a resistor of 100 ohms is placed across the two lines in question. With the transformer energized, one ampere will flow out from the transformer in the high line through the resistor and back through the 9,900 volt line. The watt-meter in the high line will read 10,000 watts. The watt-meter in the tap-line will read minus 9,900 watts. The sum-total of the watt-meter readings gives correctly the 100 watts consumed by the resistor. The watt-meters used in this way give correct results, namely, the total of their readings gives correctly the power consumed by the load. On the other hand a watt-meter connected in the supply lines of the transformer would read only 100 watts, if we neglect the losses in the transformer.

Now, suppose that the supply lines of the transformer come from a generating station in Massachusetts. The transformer itself is in Connecticut. What is the origin of the electrical energy in the 10,000 volt line? Is it Massachusetts? According to the watt-meter, Massachusetts only sends 100 watts.

[*2491*] In the 10,000 volt line by watt-meter there are 10,000 watts. What is the origin of the 9,900 watts in the tap line? Does not it come from the resistor and go back to Massachusetts?

I believe that these questions reveal the ridiculous position in which one may be placed if one assigns to unique and literal a meaning to the energy flow that is said to exist in lines by the watt-meter postulate. If the watt-meter postulate is only used for totalizing energy consumption or generation, it will give correct results. If used for other purposes it may lead to ridiculous or at least non-uniquely determinable results.

* * * * * * [*2493*]

The Witness: Well, a particular hypothesis may lead to a correct result, directly determinable, and may also lead to other conclusions. An alternative hypothesis may lead to the same verifiable result, but with respect to other conclusions may differ with the first hypothesis. Now, if there is absolutely no way of checking these hypotheses except on the points on which they agree,

then it is clear that the statements with respect to which they disagree are non-uniquely verifiable; that is, you may have more than one hypothesis which are equally good as far as anything verifiable is concerned, but they disagree on a particular point.

Trial Examiner: In other words, it can't be positively demonstrated, is that your meaning of non-uniquely verifiable?

The Witness: Well, I mean a little more than that. The best example I can give is the case of power flow. I can write many systems of power flow which will be correct as far as anything that you can determine goes. It will correctly take energy of the right amount from any particular generating system I am considering, and bring the correct [*2494*] amount to the observed load. But they will give wholly different conclusions as to which generating system is supplying which load. Now, if you want to take the stand that either hypotheses is correct, or that both are correct, then you have to say they lead to conclusions that are not uniquely determinable. One hypothesis will say one thing about the origin of power, and the other will say another thing about the origin of power, and they are equally valid, but we in our ignorance do not know which is correct. The simple state of affairs is such that with all the information it is ever going to be possible for us to obtain, nobody is ever going to answer the question in a unique way as to which load the power from a particular station goes to.

Trial Examiner: I think I understand that situation now very clearly.

Mr. Branch: I thank you for asking the question.

By Mr. Branch: *Q* Mr. Slepian, have you drawn a diagram to illustrate the matter which you referred to in the long answer which you recently gave to a question of mine? *A* Yes, I have.

Q Will you hand it to me?

(Document handed to counsel.)

Mr. Branch: I ask that this diagram—

By Mr. Branch: [*2495*] *Q* Maybe you will put your name on it

so that it will be something to identify it by. And can you suggest a title for it at the top?

Trial Examiner: I hope it isn't necessary to state the answer at the top.

Mr. Branch: This diagram Dr. Slepian has signed, and he has also entitled it, "Energy flow in tap transformer."

I ask that this sheet be marked Exhibit 81 for Identification.

Trial Examiner: There being no objection, it will be so marked.

* * * * * * [2508]

Cross Examination by Mr. WAHRENBROCK.

Q Will you explain what an electric current is, taking up, if you will, first the direct current? *A* An electric current is observed through the effect it produces. The commonly used effect is the magnetic effect or the action of current in a conductor upon neighboring iron or upon other conductors carrying current, mechanical actions.

Q I didn't understand you. Iron, did you say? *A* The action of current in a conductor upon neighboring iron or upon neighboring conductors also carrying currents. These actions are made use of in ammeters to measure current in a conductor, so that in a practical sense we say that a current is flowing in a conductor if a well understood instrument, the ammeter, connected to that conductor, gives an indication.

Mr. Branch: May I have that answer read? It is a little difficult to hear.

[2509] Trial Examiner: All right. Now, read the answer back.

(Answer read by the reporter.)

By Mr. Wahrenbrock: *Q* What is your conception of what is happening in the conductor at the time that kind of influence on neighboring iron or neighboring conductors is observed? *A* You want, I presume now, for me to give you my picture of the constitution of the conductor and the alteration that is taking place in its constitution when it is carrying current?

Q Yes. *A* I may be allowed at this moment, however, to state that that question is entirely irrelevant for such purpose that we have been discussing. The particular picture that you may have of the interior of a conductor has changed in the past 100 years quite radically, and yet the theory of the flow of currents in conductors, as established by Maxwell and those who preceded him, has not changed essentially. So that the answer which I give now as to my understanding of the nature of the processes that go on in the conductor, as I see it, has no particular bearing upon the testimony which I have previously given. However, my understanding of the nature of the metallic conductor is this: The conductor itself is made up of large numbers of in-[*2510*] dividual atoms, spaced rather rigidly from one another. As part of these atoms there are so-called electrons. These electrons do not behave like ordinary physical objects, but have laws of motion peculiar to themselves, and rather different from the laws of motion of ordinary macroscopic material objects. Now, the generally accepted picture, accepted by physicists, is that some of the electrons in the metal are capable of rather free motion and under ordinary circumstances these relatively free electrons do move about with rather large velocities and in random directions, so that in any one moment in a conductor you will find large numbers of electrons going in all directions.

Q Without interrupting your explanation, may I ask whether, when you speak of these electrons moving about at random, do you mean within a limitation with respect to the atom, or without respect to any limitation in respect to the atom? *A* These free electrons do move over distances large compared to the distance between atoms, that is, they move relatively large distances, ten or more atomic spaces at a time.

[*2511*] *Q* Are they associated with atoms?

* * * * * *

The Witness: These relatively free electrons move about over larger distances, these distances being ten or more atomic spaces, at random, and with rather high velocities.

Now, under ordinary conditions, when the conductor is in equilibrium, there are on the average just as many electrons moving in one direction as in the other direction. That is, the net flow of electrons in any direction is zero. Now, when a current is flowing in the conductor, there is a relatively small excess of electrons flowing in one direction over that [*2512*] flowing in the opposite direction, and the necessary transfer of electrons in the particular direction is said to constitute the electric current. That is, the actual observed current, observed through the effects which I have previously mentioned are believed by physicists to be the resultant of very much larger motions in the conductor of electrons in opposite directions. The motions in the two directions not balancing, giving an excess which is observed as the electric current.

Q Now, in that connection, what is your conception of an electro-motive force? *A* In the literature the word "electro-motive force" has been given two meanings, and I am not sure which meaning you are asking me to explain. I believe that in Maxwell you will find the electro-motive force is simply defined as the interval of the electric force from one point to another. That would be in a battery, for example, open circuited, there will be an external electric field, and if you integrate the electric force from the one battery terminal to the other battery terminal, that quantity will be said to be the electro-motive force between the two terminals. Now, the other meaning which has been commonly used, would be the integral of the forces acting upon charged particles, electrons, for example, which are not electromagnetic in character. That is, so-called impressed electric forces. [*2513*] Such a force might come about for example when two dissimilar metals are put in contact. There is then a contact difference of potential or electro-motive force between these two metals, and that particular electro-motive force arises from the greater attraction of the one metal for electrons than the other. Or, another example of such electro-motive force would be in the battery, the forces of a chemical character which cause separation

of charges. That is, they might be concentration gradients in the electrolite, or they could be specifically chemical activities in the electrolite. The electro-motive force in the first sense which I defined around any closed circuit is zero in electrostatic cases, in cases where the currents and voltages, and so forth, are not alternating. It is the electro-motive force defined the second way which is not zero, when integrated around a closed circuit, it is not zero, and it is responsible for the current flowing in a closed circuit in the electrostatic case.

Q Now, how does the electro-motive force affect the movement of electrons which you have previously referred to in discussing currents, or what is its relation to the movement of electrons which you have discussed as currents? *A* In a simple conductor, all at one temperature, of a uniform material, the motion of the electrons statistically is determined by the electric intensity, or electric field inside that conductor. That is, the excess of motion of [*2514*] electrons in the direction of the electric field, over that of the motion of electrons opposite to the electric field, is proportional to the electric field and the constant of proportionality is a property of the material directly related to what we ordinarily called the resistivity of the material. If the material is not uniform, or not at one temperature, then the relationship is not so simple. We then have—we may have an electric field then with no current, or we may have a current with no electric field. And I can develop that further if you like, but it is only in the simple case, where the material is uniform in nature, and at one temperature, that we have the simple relationship between the electric field and the net current that I have just given you.

Q Does that mean that in your simple case which you have cited, the presence of an electro-motive force means that the electrons move differently than they would otherwise? *A* I do not say electro-motive force. I said electric field. The electrons in the electric field have their motions slightly altered, according to the concepts of physicists.

[*2515*] *Q* I am not sure that I understand the qualification

which you introduced in your last answer when you qualified your preceding answer as not relating to electromotive force. I thought that I had asked in the preceding question about an electromotive force. Can you clear up my misunderstanding in that connection? *A* Are you asking for the difference between electromotive force and electric field?

Q If that will explain your previous answer, which I understand now was addressed to an electrostatic field rather than to electromotive force? *A* Yes. The electromotive force, according to either of the definitions which I gave before, the electromotive force obtained by integrating some particular force, say the electric field from one point to another. Now, the behavior of the electrons in a metal at a particular point depends only upon the state of affairs at that particular point, and the state of affairs at that particular point is given by the electric field at that point and is not determined by the things that happen remote from that point. So that, if you ask as to what is happening to electrons at a particular point, you must use terms that apply only to that point and not to remote points, so that the proper term to use there is the electric field which is defined at that point rather than electromotive force which necessarily involves [*2516*] the electric field over a large region, including much more than the particular portion and space about which we are discussing and at which we are discussing the motion of electrons.

Q What does an engineer mean when he refers to electromotive force? *A* Well, I am described as an electrical engineer, so that the answer that I have just given, at least is the answer of one electrical engineer. If you will tell me what you mean by an electrical engineer, perhaps I will try and answer your question.

Q Which of two meanings of electromotive force to which you have referred is the common meaning in engineering parlance? *A* I believe the second definition is more widely used among engineers.

Q Is it common to speak of current as being produced by an electromotive force? *A* Yes, in loose language, yes.

Q Is such a statement commonly made by engineers and in engineering texts? *A* Ordinarily conversation is carried on to transmit information from one person to another, with the intention of each party to get at some common understanding or truth, and it is not necessary to use great care in defining terms, because [*2517*] as soon as it is clear that the greater care is necessary such care will be taken, so that I think, in ordinary language, engineers talking among themselves will use terms loosely, but undertake to define them more precisely as they need to. Now, ordinarily, I suppose, engineers would accept the statement that an electromotive force produces a current, without dissecting it, because he knows that if any questions arise that need further elaboration, that he will be permitted to make a more precise statement than that electromotive force produces current.

Q What is commonly meant by that statement, that electromotive force produces current? *A* Well, I think all that the electrical engineer means is that he may have a circuit in which there is both current and electromotive force and that there will be some relationship between them.

Q Now, will you explain what your conception is of the factors which determine the distribution of current through the cross-section of a conductor, and my question relates now to alternating current? *A* At each point in such a conductor the current density is given by the electric field at that point.

Q And when you say "point" in a conductor, are you referring to a point in the cross-section of the conductor? *A* A point in the cross-section, so that the current [*2518*] density at the center of the conductor is given by the electric density or the electric field at the center, multiplied by the conductivity of the material at that point.

Q Multiplied by what? *A* By the conductivity, the reciprocal of resistivity. The current density at the periphery is given by the electric field at the periphery, multiplied by the resistivity of the material there. Now, in my previous statement I said that the current density at the center was different in phase from the cur-

rent density at the outside at the periphery, so therefore you may conclude then that I also implied that the electric field at the center was different than the field at the periphery. Now, the electric field may be calculated from the distribution of electric charges and from the distribution of magnetic fields which may be varying in time. The particular situation of the conductor carrying current, the reason for the electric field at the center of the conductor being different from that at the periphery, is to be attributed to the magnetic, the varying magnetic, field produced by the current which is circulating in the conductor.

Q I wish you would consider the hypothetical situation in which gases from two sources are introduced into a relatively long pipe of relatively small diameter, such as a common gas transmission line. The gas from one source— [*2519*] *A* May I interrupt? Will you repeat that? Just the last question?

(The question is read.)

Q (Continuing.) The gas from one source has mixed with it some smoke and that from the other source has not. Would you expect the gases from those two sources which are emitted from the distant end of that pipe would be mixed? *A* Under ordinary conditions we would say they would be mixed.

Q Well, now, what is the effect of the qualification, under what extraordinary conditions would they not be mixed? *A* The gas was not specified. If the gases were extremely low temperature, for example, the mixing might be negligible.

Q You have in mind a theoretical zero? *A* No, a practical temperature of say one degree absolute.

Q It wouldn't be a gas at that temperature, would it? *A* Helium would.

Q Helium would? Those are the extraordinary circumstances to which you referred? *A* Well, you asked me a question as to whether the gases would be mixed or not. I said ordinarily they would be, and then you asked me further under what circumstances they would not be, and I gave you one circumstance when they would not be mixed.

Q Now, under ordinary circumstances then, with that under- [2520] standing, I believe you would expect that the gases would be mixed when they are emitted from the far end of the pipe, is that true? *A* Yes.

Q I understand that you don't believe that when electric current from two sources is supplied to the same conductor, a conductor of relatively small cross-section and relatively long length, that the current at the far end of the conductor is mixed? Am I right in that understanding? *A* I might say that we would need a little clearer understanding of what you mean by the currents being mixed. In a given conductor carrying current, as I have said before, the electrons on the electron basis, the electrons are moving in quite random directions, and how you are going to attach an ownership of a particular electron to one circuit or the other circuit, I don't know. I don't know what it means, but of course you are not talking about mixing of electrons, you are talking about mixing of currents, which is a statistical average of many electric currents. Now, what in the world you mean by mixing of currents, which is a statistical average of tens of millions of electrons moving in complicated ways per cubic centimeter in a metal, I don't know. If you will define the meaning of the word "mixing" in such a way that I will understand it in some physical way, so that I can, after you tell me what you [2521] mean by "the current being mixed" devise some test that will enable me to answer your question, then I will attempt to answer your question.

Q Well, where a current then is supplied to a conductor from two sources, if we look at the point where the two conductors come together into a single conductor, would it be proper to say that the current in each source is the statistical average of the electrons in that conductor at that point? *A* At each point in the conductor the current is the statistical average of the motion of the electrons. At each point in the conductor, I said nothing about source. I don't know what you mean by saying "in each source".

Q Then, beyond the point at which two conductors each carrying a current are joined, the current is likewise, at any particular point, the statistical average of the— *A* Motion—

Q —of the action of the electrons at that point? *A* At that point, yes, at this different point.

* * * * * * [2522]

Q When on your direct testimony, you gave the example of a generator at A generating during a given period of time 10,000 kilowatt hours, connected to a line at the extreme end of which is another generator, B, generating during the same period of time 10,000 kilowatt hours, with a load C near the A generator taking 10,000 kilowatt hours during the same period of time, and a load D near the B generator, taking during the same period of time 10,000 kilowatt hours, I believe I understood you to say that so far as physically verifiable or observable facts were concerned, it was reasonable to assume that generator A was supplying load D, and generator B was supplying load C; is that correct? *A* By reasonable, you mean it is just as permissible to use that picture as any other?

Q Is the latter what you meant to say, that it was just as permissible to make that assumption as any other assumption? *A* I am not able to know what I meant to say unless I have my answer read.

Q Well, without referring to what you meant to say, [2523] what is the fact, in your opinion?

Q Will you state the question now as a question?

* * * * * *

A As far as I remember, I did not use the word "reasonable" in the answer to that question.

Q Would it be just as reasonable to make that assumption as any other assumption? *A* In the absence of any motive for choosing one over the other, I would say it was just as reasonable.

Q Just as reasonable to assume that A supplies D, and B sup-

plies C, as to assume that A supplies C, and B supplies D? *A* Absolutely.

Q And in such a case, would you say that there was any measurable transmission losses? *A* Would you repeat the question, the last question again?

(Whereupon the last question as above recorded, was read by the reporter.)

The Witness: In which case, please?

By Mr. Wahrenbrock: In the case of your assumption that A supplies D, and B supplies C?

A There would always be losses associated with the generation of energy at the two generators A and B, and the [*2524*] consumption of energy at the two loads, C and D. In other words, the total of energy generated at the two generators would exceed that consumed at the loads.

Q Would there be any measurable transmission loss with respect to the transmission of electric energy between points C and D? *A* If by transmission losses you mean losses in the conductor in the line joining A and B, C and D, the losses in the case that I have just been considering would be very small, practically zero.

Q Would there be any difference in the transmission loss, assuming A to supply D, and B to supply C, from the transmission loss assuming A to supply C, and B to supply D? *A* The assumption made as to which generators supply which loads have nothing to do with the losses.

Q Then do I understand that there would be no measurable difference in transmission loss if A supplied D and B supplied C, any different from the transmission loss if A supplies C and B supplies D? *A* I have tried to explain that there is no possible way of determining whether A supplies C and B supplies D or A supplies D and B supplies C; so that, saying that A supplies B or A supplies C and B supplies C or B supplies D, saying that, has nothing to do with the condition of currents which are responsible for the heating or the distribution of voltages which will be [*2525*] responsible for dielectric losses, and so on.

Q If, as a matter of fact, it was physically verifiable that A did supply D and B did supply C, the transmission loss would be no more than would be the fact if it could be physically verified that A supplies C and B supplies D. Is that true?

* * * * * * [2526]

A I have stated that because of the very nature of electrical energy it will be impossible to verify that energy from A goes to C rather than to D. Your question is equivalent to asking me, "If two and two made five, how much would three and four be?" In the nature of things two and two can't make five, and therefore I cannot answer the question.

By Mr. Wahrenbrock: *Q* Do I understand you to say that A can't supply B and B can't supply D? *A* I say that you can assign the energy from A and B to C and D as you please. So far as any physically verifiable facts are concerned, all that we know is that the total generated by A and B equals the total consumed by C and D, allowing for certain losses.

Q I want to add one more assumption to the case we have been discussing, which was the case you first put on direct, and that is, assume that between C and D in the line the circuit can be opened. Will there be any difference in the observable transmission losses during the same period of time and under the same conditions, with the switch open as with the switch closed? *A* Well, in a practical case there would be a slight difference. The two stations are held together by the line, and currents must flow holding them together.

[2527] *Q* The difference, then, is the synchronizing current in the transmission line between C and D? *A* Yes, you can describe it so.

Q And so far as any assumed flow of energy between the points C and D is concerned, there is no measurable transmission loss? *A* The loss in the conductor is determined by the current in it, and has nothing to do with the assumed energies on the conductor.

Q I am not sure that I understand your answers to the preceding

line of questions, and I would like to see if I can clarify my understanding by this variation of your problem. I believe that you assumed and in my questions I have assumed that the load C is near the generator A, and the load D is near the generator B. I wish to assume that the load C is at the generator A and the load D is at the generator B. On that assumption, if the generator A and the load D are eliminated, will the transmission loss in generator B serving load C be determinable? *A* The loss in the conductor will be determined by the current in the conductor.

Q And under the circumstances given, it would be determined? *A* Not merely from the kilowatt-hours.

[2528] *Q* What more would you need? *A* I would need to know the voltage principally, and also the phase angle between current and voltage. I would then, of course have to know the size of the conductor, and so forth.

[2529] *Q* All right. I just want to get those factors that need to be known. You would need to know the voltage? *A* Yes.

Q You need to know the phase? *A* From the kilowatts, to derive the current, assuming that there is nothing extraordinary about the system, I would need to know the voltage and the power factor.

Q Voltage and power factor, and the size of conductor. *A* Then to determine the resistivity of the conductor, I need to know its size and material, and so forth.

Q Now, knowing those facts, you could determine the transmission line loss? *A* I would be able to approximately calculate the heating of this transmission line.

Q And assuming that from those facts you made the determination: Now, assuming that those factors remain constant, but it is the other generator and the other load, the other generator operating and the other load is being supplied, and the load we have just been considering is not being supplied, and the generator we have just been considering is not operating, would the transmission loss be the same?

* * * * * * [2530]

The Witness: The loss in the line would be approximately the same.

By Mr. Wahrenbrock: *Q* Why do you introduce the qualification "approximately"? *A* Well, to be on the safe side.

Q Well, do you have any factors in mind which would make it not exactly equal? *A* Yes. The distribution of potential along the line wouldn't be constant. The capacity effects have to be taken into account and—

Q Would that be any different if a load at one end is being supplied from the other end, and if the load at the second end is being supplied from the first end, voltage, kilowatts and power factor, conductor size, and attendant circumstances remaining constant? *A* If the system is completely symmetrical in every way, it would be. But you failed to state it was symmetrical. You said the same system.

Trial Examiner: May I just ask what the witness means by symmetrical?

The Witness: Well, you require the transmission line at each end, at any one point, to be exactly identical with the [2531] construction of the transmission line at a symmetrical similar point. That is, take any one point on the line near the generator A, you must have a similar construction, similar height of lines, and so forth, at a corresponding point, a similar distance, from Station B. And that kind of symmetry is to extend throughout the system. If the line goes over a mountain near A, it must go over a mountain near B.

Trial Examiner: That clarifies it very well.

By Mr. Wahrenbrock: *Q* Now, continuing to put a third situation, where both generators are operating, and both loads are being supplied simultaneously, would the transmission line loss be the same as in each of the preceding cases? *A* The loss on the transmission line in that case would not be the same as that in each of the two cases we have just been discussing.

Q Would it be greater or smaller? *A* The losses in the line would be smaller.

Q Relatively how much smaller? *A* It would be very considerably smaller.

* * * * * * [2532]

Q I would like now to take this hypothetical and ideal situation, and relate it in terms that we can understand something about the distances involved. I would still like to make the same assumptions about the amount of the two loads, and the amount of the two generators, the amount of the two generators each are generating, but I wish to assume that generator A is a steam generating plant in Nashville, Tennessee, and generator B is a steam generating plant in Mobile, Alabama; load C is the utility load in Nashville, and D is the utility load in Mobile. Now, do I understand you to say that in your opinion it is as reasonable in the facts you stated in your hypothetical case to assume that the Nashville load is supplied from the Mobile generating plant, and the Mobile load is supplied from the Nashville generating plant, as to assume that the load in each city is served by the generator in each city? *A* I don't believe I used the word "reasonable". I said it is permissible, and if you choose to use the one description for a certain purpose to suit your convenience, you may do so, [2533] or you may use the other. They are equally satisfactory descriptions as far as physical tests go.

Q Do you mean it is not as reasonable to make one assumption as the other? *A* No, I do not. Under one set of circumstances you may find it convenient to use one description, and under another set of circumstances you may find it convenient to use the other. It is a matter of convenience, not a question of reasonableness or unreasonableness.

Q Then, if you say you do not say that it is not as reasonable, than you mean to say it is as reasonable? *A* I think I have made clear what I meant to say. Now, if you will ask me a specific question, I will try to answer it.

Q Is it as reasonable to make one assumption as the other? *A* Depending on the purpose you have in making the assumption.

* * * * * * [2535]

Q If for any purpose it becomes important to take certain steps with respect to sources of electric energy generated in one State and consumed at a point outside thereof, would it be necessary, in your opinion, in order to accomplish that result, in the case of interconnected utility systems operating in synchronism, extending over two or more States, with loads in each State and generating plants in each State, to include all of the generating plants in all of the States?

[2536] Mr. Branch: I object to that question. It is too vague.

Trial Examiner: It doesn't seem to me that the question is vague, except as to one point. The expression as to the taking of certain steps, I don't think is material to the question. It seems to be only confusing. I understand simply that if it becomes necessary to know, can it be known. Is that the general idea of the question?

Mr. Wahrenbrock: If the Examiner please, as I understand the witness's testimony, it is that in a case of such an interconnected system, you cannot physically verify which generator supplies which load. In order then to be sure of catching the generator which supplies a particular load, I want to know if you would have to catch all the generators.

Mr. Branch: Well, I don't think this is cross examination of anything that we went into, and I don't know exactly what he means by "catching" generators.

Trial Examiner: I don't think anybody expects him to stand down in front and catch it physically. It seems to me that the question as last stated may be answered. The objection is overruled.

A The principles and laws of electrical engineering upon which I have based all my testimony, make no reference whatsoever to State lines or geographical locations. The statement remains,

that when several generators or sources of electrical energy are connected to a system and several loads, it is im- [2537] possible for any physical means to determine the origin of the energy which any particular load receives, with respect to the various generators, to know which generator supplied which load. When I say that it is impossible, I mean that you can give a thousand different answers and they will all be equally correct, so far as the basic principles of electrical science are concerned, and this is true, regardless of State lines.

By Mr. Wahrenbrock: *Q* Well, then, when you have interconnected utility systems with several loads in several States and several sources of supply of energy in each of the several States, it is your position that it cannot be demonstrated by physical means that any particular source of energy is supplying any particular load? *A* Where there are several sources of supply adequate for supplying that particular load, it is not possible to uniquely affirm that some particular source is supplying that load.

Q And the closest to determination that can be made is that some one or more of the sources of supply, of all the sources of supply, is carrying that particular load? *A* When you say that a load is being fed or supplied by some of the generators in the system, all you can mean is that the total of the energy generated at those sources exceeds that [2538] consumed by the load?

* * * * * *

Q And in an inter-connected utility system operating in synchronism, where there are loads in each of several States and generating plants in each of the several States, the only identification that can be made of the source of any electric energy moving across State lines is that it must come from some one or more of all the generating plants? Is that correct? *A* I only know of energy being consumed or generated, generated at the sources and consumed at the loads. That I can measure.

Q Well, we do know that it gets from one to the other, don't we? *A* We know that it is generated at the one place and con-

sumed at the other. If you mean by that it gets there, then it gets there. All I mean is that it is generated here and consumed there.

Q Well, you are not assuming, are you, that the energy which is consumed at the point of the load is created in the strict sense, at that point, do you? [2539] *A* Well, I only know that we must have the total generation equal to the total consumption.

Q Energy can't be created or destroyed, can it? *A* Total energy generated is equal to total energy consumed. That is all I know. If you want to describe that balance by saying energy cannot be created and destroyed, if that is what you mean, good.

Q Well, do you recognize that there is any such thing as transmission of electric energy? *A* I will tell you what I mean by transmission of electric energy.

Q If that means that you do recognize that there is such a thing as transmission of electric energy— *A* Yes, I recognize transmission of electric energy.

Q What do you mean by transmission of electric energy, which you recognize? *A* The generation of electric energy at one geographical point and its consumption at another geographical point with intervening electrical apparatus, transformers, wires, and so forth.

* * * * * * [2540]

Q Does the presence of transformers in the intervening electrical system make any difference to such transmission of electrical energy? *A* I don't believe I understand the question.

Q Well, I believe in your last answer you mentioned transformers. Now, do I understand that you include those in the system by which electric energy is transmitted from other sources of supply to its loads? *A* Yes, in general, yes.

[2541] *Q* If in an interconnected utility system, operating in synchronism, extending over two or more States, and having in each of the several States loads, and in each of the several States generating plants, it becomes important to ascertain which of the generating plants is the source of electric energy which is transmitted by the intervening system to a particular load, will it be

necessary to include all of the generating plants in order to be sure to include any particular plant or plants which is supplying that load?

* * * * * *

The Witness: The purely technical question is entirely unaffected by the importance to human beings as to what the result is. The important part of it is entirely unimportant, and I don't consider it in my answer, whether it is or is not important.

[2542] I believe I have made clear that it will not be possible to determine the origin of the energy consumed at a particular load as distinguished between several stations, no matter how much you take into account of the system. You can consider the whole system or only part of the system. You won't get any answer that is uniquely correct.

Q All that can be ascertained is that the particular load must be supplied from some one or more of all of the generating plants? *A* You can be sure that the energy consumed at the load, measured by whatever way you like, will be less, at least no greater, than the sum of all the energy generated at the various stations connected with the system, and that is all you will know.

* * * * * * [2543]

Q Do I understand you to say then, or to mean then, that if we do know all of the generating plants in an interconnected utility system, operating in synchronism in several States, with loads in each of the several States, and generating plants in each of the several States, that we can assume that one or more of those generating plants supplies any particular load, and that we can not verify any fact beyond that? *A* Well, I have tried to make my position clear on that. There is no possible way in which you can identify the energy received at the load as to source. You can, if you please, allocate energy from one source to one particular load, as you choose, and so long as you make the sum total of the energy you assign as coming from the various stations balance the energy, the sum total of energy you assign to the

various loads, you will contradict no observable physical facts. If you choose to make one allocation of energy, or more than one allocation of energy, or make no allocation at all, it is entirely at your pleasure.

Trial Examiner: Your answer doesn't depend in any way, does it, on the hypothesis advanced by counsel that there must be a load in each case affecting the source of energy?

The Witness: No. The fact that the described system extends over several States is entirely immaterial.

* * * * * * [2545]

Q I should like to refer again to the earlier illustration which you used in which there is connected to a line a generator at one point, A, supplying 10,000 kilowatt-hours during a given period, and a generator B, at the end of the line supplying simultaneously or during the same period 10,000 kilowatt-hours, and a load C near the generator A, using 10,000 kilowatt-hours during the same period of time, and a load "D" near the generator "B", using during the same period of time 10,000 kilowatt hours, and ask you whether, in what you said about the possibility of generator B supplying all of the load C and generator A supplying all of the load D, you meant to be understood as saying that there ever had been at any time a flow of energy over a conductor and simultaneously a flow of energy over the same conductor in the opposite direction. *A* As I remember, I said that it is quite permissible to postulate or assume an energy flow from the generator A [2546] to Load D, and also an energy flow from generator B to load C; that if you chose to confine those flows that you are postulating to the line, you are free to do so, and if you confine them to the line, why naturally there will be simultaneous postulated flow of power in the two directions along the line.

Q It is permissible to postulate or to assume, but do you say that there ever has been demonstrated flow of energy in one direction and simultaneously over the same conductor, a flow of electric energy in the opposite direction? *A* There has never been proven any flow of energy in the line in any direction.

Q Therefore there never has been demonstrated a simultaneous counterflow of energy? *A* I have repeatedly stated that the flow of energy—

Q Well, can my question be answered yes or no? *A* Is this a new question now?

Q The question I just put, can it be answered yes or no?

Trial Examiner: Does the witness have the question?

The Witness: I would like to have it read.

Trial Examiner: Will you read the question back for the witness?

(Question read.)

A That question, of course, is not complete, because it refers to a previous question.

Trial Examiner: Do you wish the previous question read?

[2547] The Witness: Yes.

Trial Examiner: Read the previous question and answer the question.

(The question is read.)

A And therefore, Yes.

Trial Examiner: Will the witness state what he means by "Yes"? I don't know whether I understood that.

The Witness: You want to know what I meant by "Yes"?

Trial Examiner: Yes. Do you mean "Yes" to the last question as it is worded? I don't know whether I understand fully the meaning as to what a "Yes" shows. Will you again read that last question?

(Last question read again by the reporter.)

Trial Examiner: I think I will have to ask counsel to put that in a little bit different form because a "Yes" is not understandable to me as the question stands.

By Mr. Wahrenbrock: *Q* Has any instance of simultaneous counterflow of electric energy in a conductor ever been demonstrated? *A* Yes, in so far as any flow can be demonstrated.

Q And you have just said that no flow can be demonstrated. *A* I am not certain of the precise words that I used. At the time

I made the statement I was replying to a question that is obviously asked for physical means for ascertaining the nature of the energy flow, direct observational means, on the [2548] conductor itself. Now, no such means are available. Now, in the case of energy flow, we may say that a system of energy flows in the conductors of a system is demonstrated if we show that such a system of flows in no way contradicts any observable fact about the system. Now, if you accept that as meaning a demonstration, then I will say systems of flows or systems of flows and counterflows can be demonstrated. If you mean other than that, then I will have to deny that it can be demonstrated.

[2549] *Q* Has simultaneous counter flow of electric energy in an electric circuit ever been demonstrated by observable facts? *A* Only by this observable fact, that the flows and counter flows assumed will correctly account for the energy generated at the various places where it is observed to be generated, and the energy consumed at the various places where the energy is consumed.

Q But such an assumption is not the only assumption consistent with all facts? *A* No.

Q Then is it accurate to say that simultaneous counter flow of electric energy in a conductor has never been uniquely demonstrated by observable facts? *A* I think I would agree to that, where I assume by the word "uniquely" you mean that other systems can equally well fit the situation in hand.

Q Where there is one generator connected to one load, is the flow of electric energy in the connecting conductor uniquely demonstratable? *A* No.

* * * * * * [2550]

Q Where you have one generator connected to a load A, can the flow of electric energy from that generator to that load be demonstrated? *A* Well, if I understand your question correctly, I believe the answer is no. All that is observed is the generation of energy and the simultaneous consumption approximates the equality of the two magnitudes. Now, if you are asking me to demonstrate something more than that, I cannot do it.

Q There is no way under such circumstances of demonstrating that the electric energy generated is the electric energy consumed? *A* The identity only resides in the equality of the magnitudes. There is no other mark that will give identity to the energy.

Q Is there any difference between—I will withdraw that. I wish you to assume a generator A connected to a load B, by a conductor, and a generator C connected to a load D by a conductor, both generators generating the same amount of electric energy, both loads utilizing the same amount of electric [*2551*] energy. Does the electric energy consumed by load B have any greater—have any other relation to the electric energy generated by the generator A than it does to the electric energy generated by generator C?

* * * * * * [*2553*]

A It is not stated whether the generator A is connected to the generator C by a conductor or not.

Q No connection. *A* Oh, they are not connected?

Q That is right. *A* Then, in that case, the energy generated by A will balance except for losses the energies consumed at B; and the energy generated at C will equal the energy consumed at D. We thus have a special relationship between A and B that doesn't hold between C and B.

Q Making the same statement of facts, generator A is generating 10,000 kilowatt hours during a given period, it is connected properly to a load B, which is consuming during the same period the same amount of electric energy, we will neglect transmission losses, a separate unconnected generator C is supplying the same amount of electric energy through a proper connection to another load D; in both cases the generator is [*2554*] generating 10,000 kilowatt hours, in both cases the load is utilizing 10,000 kilowatt hours. Now, in both cases then, the load is equal to the generation. Do you follow me so far? *A* In each case?

Q In each case the load is equal to the generation. *A* Yes.

Q Then, on my assumption that the generation at A is equal to the generation at B, it happens that each load is equal to the

generation in the other generator. Do you follow me so far? *A* Yes.

Q Now, aside from that equality of amount, is there any relation between the electric energy consumed by one load, by load B, is there any other relation between that electric energy and the electric energy which is generated by generator C? *A* In the case of no connection between A and C, the—

Trial Examiner: Between B and C, I believe it is.

The Witness: The generators are A and C and the loads are B and D?

By Mr. Wahrenbrock: *Q* Yes. *A* And in the absence of connection between A-B and the system C-D we would have equality between B and A regardless of what loads may be on D or generated at C. There is that fact that with the lack of connection load at B always equals [*2555*] the generation at A, makes a special relationship between those two quantities that is characteristic of the lack of connections between the part AB and the part CD. Now it may be that some brief moment in time the generation at A happens to equal the generation at C. That is a purely accidental occurrence. You would have to work very hard to find such moment when those powers just happened to be equal. At such a particular moment, when the power generated at A and the power generated at C happened to be equal, it is true that the energy consumed at B and the energy consumed at D would also be equal, and at such a brief moment you can if you like assign the energy at A to the load D or assign the energy at the load B to the generator C, but that would be a very brief, transient moment when the two happened to coincide in quantity. However, in this case of lack of connection, the energy consumed at B always equals the energy generated at A. Therefore, it certainly is a matter of great convenience in that case of lack of connection to describe that situation by saying that B receives its energy from A, meaning thereby only that under all circumstances the energy consumed at B equals that of A. If there is lack of connection then you know that the energy at B always

equals that generated at A, and to describe that set of affairs you may use the popular language term by [2556] saying that A supplies B, but all you mean is that the energy generated at A equals that consumed at B under all conditions. Now as soon as you put in a connection that equality of consumption at B with the generation at A ceases, and you can no longer use the every day expression that A supplies B because you no longer have that equality.

Q Now, as long as the generator A is connected to the load B, the amount generated at A is at all times equal to the amount generated by the load B. Is that right? *A* In the lack of other connection.

Q In the lack of other connection? *A* Yes.

Q This being the only connection, and the fact of that continuing equality is the only observable fact to result from the connection? *A* From the lack of connection.

Q From the connection between B and A? *A* Well, the mere connection B and A itself is not enough, you must have lack of connection with other parts of the system.

Q The fact of the connection of A and B and the absence of any other connection. I have mentioned no other connection and there isn't any for any of these purposes. I would like to have that assumed to simplify the discussion, please. The existence of a connection between A and B results [2557] in the continual equality of the generation and the load A and B. *A* The existence of an exclusive connection between A and B?

Q Yes, and the existence of an exclusive connection between C and D results in an equality of load and consumption in C and D. Now there is no connection between A and B on the one hand, and C and D on the other, yet if there is at any moment the generation at C equals the amount of the consumption in the load B, would you say that the relationship between the generation C and the load B is the same as the relation between the load B and the generation A, with which the load B is connected? *A* Well, there is equality in magnitude.

Q And that is all that you recognized?

* * * * * *

The Witness: Unless you permit variations in load which would at once reveal that A and B remain equal and C and C remain equal but not A equal to B. Unless you permit such variations, you can distinguish nothing else.

By Mr. Wahrenbrock: [*2558*] *Q* In the absence of variations, the relation of the generation at A, with which the load B is connected is just the same as the relation of the load B with the generator C with which the load B is not connected. Is that true? *A* Yes, it is merely an equality in magnitude. That is all you can determine by this one observation.

Q What do you mean "That is all you can determine by this one observation"? *A* Well, there is no inherent identification in the powers received by the loads B and D. We may for convenience allocate energy from A to B and energy from C to D if it is convenient. Now, if the systems are not connected, then we observe that the energy at A equals the energy at B under all circumstances, and the energy at C equals the energy at D under all circumstances. Therefore, it is convenient to say now we are going to allocate the energy from A to B, and from C to D because we observe they are always equal. However, if there is no opportunity for me to observe that A is always equal to B, and C is always equal to D, but sometimes differ from each other, if you will not permit me to make such an observation, then I will see no convenience served by saying that A feeds C or A feeds B or A feeds D. It is entirely a matter of convenience in making orderly and systematic all of the possible observations that you might make on a system.

[*2559*] If the systems are not tied together, then we will always observe that A is equal to B and C is equal to D under all circumstances, and the saying that A feeds B and C feeds D is simply a convenient way of bearing in mind that A always equals B and that C always equals D and nothing more.

Q And the allocation of a load to a generation is merely a matter of mathematical quantitative equivalents? *A* I am afraid I don't understand the question.

Q As long as a supply of energy is quantitatively equivalent to the amount consumed at another point, the one may be allocated to the other? *A* Yes. Of course, when I say that, I mean that the other loads and the other generations in the system must also be properly allocated to each other.

Q I am not talking about the system. I have two isolated phenomena, consumption of energy at point B and—when I say "consumption", I mean utilization of electric energy at point B and a supply of electric energy at point A. Now, do I understand that in order to allocate the supply to that load, it is only necessary to know they are quantatively equivalent? *A* As far as any physical principles go, that is all you need to know.

* * * * * * [*2560*]

Q So that in the sense in which you have been using allocation, it is not necessary to have an electric circuit between the supply of electric energy and the load? *A* No, it is not necessary. I have, however, tried to bring out that the matters of allocation are entirely those of convenience in describing the relations which exist between the generation and the loads in a system. If a particular load is entirely disconnected from a generator, the generation at that generator may at one moment equal the consumption at that load, but that will in general be so exceptional a case unless the generator is tied to the load by some system, thereby very exceptional that the two will equal in magnitude, so that I don't see how any circumstance would exist where a person would regard it as convenient to say that that load was supplied by that source.

If, however, he found that there was always equality between the generation and the load, as would be the case if there was a single exclusive connection, then I could understand a person, purely as a matter of convenience in describing the relations

which persists, in saying the generator supplies that load, meaning thereby that there is in it nearly an equal but [*2561*] a continuing equality.

Trial Examiner: You would say then that that continuing equality was not accidental in that case?

The Witness: Yes, that it was part of the function of the connection to assure that equality persists.

Trial Examiner: That completes what I wanted.

By Mr. Wahrenbrock: *Q* Now, if A and C are sources of supply of direct current and the amount of energy being supplied is constant, and the amount being supplied at A is equal to the amount being supplied at C, then at any time you would be able to allocate without load at B to the supply at C with which the load B is not electrically connected, as accurately as you could allocate the load B with the supply A?

Trial Examiner: Do you understand the question?

The Witness: May I ask whether the question is at all different from the preceding question except the substitution of direct current for alternating?

Mr. Wahrenbrock: It is just the direct current, and the maintenance of the constant amount being supplied.

Trial Examiner: The fact that the supply at A and the supply at C are the same constant, plus the fact that there is direct current?

The Witness: Then it is the same question, asking me if there is any special relationship.

[*2562*] By Mr. Wahrenbrock: *Q* That is right? *A* Well, I don't see that the relationship is at all altered. The statement that the two are to be kept the same in amount is something that actually cannot be carried out. It is impossible to keep two independently connected loads and sources at exactly the same intensity so that at the best we can only ask for an approximate equality, and the fact is that the loads can be varied in each system, and when they are varied, each load will remain equal in magnitude to the generated supply of that system. The same will hold for

the other system, with the connections that you have described, each generator generates energy equal to that consumed by the load to which it is connected, and that relationship persists, regardless of what is done to the other disconnected system, and it is that state of affairs that tells or impels us, makes it to our convenience, to say that the generator A supplies the load B, merely in that way describing the fact that the energy consumed at B always equals the energy generated at A, regardless of what you may do to the rest of the system.

[*2563*] *Q* If, however, we assume the constancy of the amount of electric energy being supplied and equality as between the two sources of supply, then you would allocate, would you, by your method, the load B to either source of supply. *A* If the generation of the two sources was always the same, and the energy consumed at the two loads was always the same, under those circumstances there would be no reason for you to allocate one load to one source, because there would be no convenience served. Unless you have variations which make it convenient to make a particular kind of allocation, you are free to make any allocation you please.

Q Even though the load B is electrically connected to one supply but not to the other? *A* The only function of the particular connections you have is to insure that when you vary your loads they will be variations independently. How can one determine there is no one connection between the two loads? One may make a visual inspection, but one may fail to observe a hidden conductor that is tying them together. No man can be sure there is no connection between one and the other except observing the generation at A equals the generation at B. If he observes that, then he will be sure there is no interconnection, or at least it would be better said—it would be better if we simply define connection or interconnection in terms of the relationships which these energies have between themselves. If the [*2564*] energy consumed at B always equal the energy consumed at A, under the most various conditions, then you might say that A and B are electrically dis-

connected from all other systems. That would be the mark of its lack of connection, namely, that the energy produced at A equals the consumption at B. That would be a far surer mark than any visual inspection.

Q And that would be true in spite of any visual observation of apparently continuous copper conductors of the usual type between the generator or the source of supply A and the load B, and the absence of any conductor of any recognized type between the source of supply C and the load B? *A* Let us see. The question is not complete in itself. It says "That would be true," and you are referring to my answer?

Q Yes. *A* So I think I will have to have the answer read and then the question.

Trial Examiner: The reporter will read the answer back to the witness.

(Whereupon the last answer as above recorded, was read by the reporter.)

Mr. Wahrenbrock: I will reframe the question.

By Mr. Wahrenbrock: *Q* I believe it will be clearer if I ask you whether, assuming a constant supply of electric energy at A, continuously equal to the supply of electric energy at point B, the [2565] fact that load B is electrically connected to supply A by an obvious copper conductor or set of conductors, whereas the supply C is so far as the most careful inspection will show, carefully insulated from load B, would not prevent you from allocating the load B to either source of supply equally validly, in your opinion? *A* The connection—the description of the connections would be of significance to me only in so far as they affected possible relationships between the energy generation and the energy consumption at the different generating stations and the load. A direct metallic connection observed between A and B, and a lack of direct connection observed between A, B and C and D, would be some presumptive evidence to me that probably the consumption at B is going to stay equal to the generation at A. However, if in spite of that observed connection between A and B, and the

lack of observed connection between A, B and C and D, I saw a lack of equality between generation at B and consumption at A, then I would start hunting for a connection that I had overlooked, or I would look for some other means of transferring energy from one system to the other, perhaps radio or something of that sort. That is, the isolation of system A-B from C-D, to me would be proven by the continued equality of the generation at A, with the consumption at B. I would accept that as a definition of isolation, a preferable defini- [2566] tion of isolation, over any visual inspection.

Q Yes. Now, that answer, as I understand it, goes beyond my question, because my question assumed that there were constant and equal supply of electric energy at A and B, and in your answer you have assumed variations which you would seek to find an explanation for. Now, putting my question again, assuming constant and equal supply of electric energy at A and B, the fact that A is apparently electrically connected to B, whereas C is apparently well insulated from B would not, in your opinion, affect the validity of an allocation of the load B to C? *A* Well, I would say that if the magnitudes of these loads are equal, and one is compelled to assume their continued equality, there would be absolutely no purpose served in making one allocation rather than the other. The visual inspection might prompt one to make one allocation rather than the other, because one ordinarily is not restricted to keeping the loads constant. When one sees that connection, then one thinks, oh, well, this load can change without the other changing. That is, the lack of connection, you can say this load can change without the other changing. You, however, are taking a set of circumstances where one ordinarily rightly draws the conclusion, namely, the set of circumstances being that there is no visible connection, and from which one can ordinarily draw the conclusion that the loads A and B will remain equal in spite of [2567] what may be done to C and D, and where one is accustomed to deriving, to describing that relationship by saying that A supplies B, and C does not supply B, you are taking that set of

circumstances where from observation of lack of connection I would draw these conclusions, and now you are eliminating one of the reasons that I ordinarily have for making that conclusion and hoping that I will not observe that you have eliminated the reason, or your elimination of the reason for not making that conclusion, and say, yes, I would continue to make that conclusion. I would make that conclusion if I were talking to somebody who would allow me to correct myself. What I mean is this: The situation you are presenting is not an accurate situation. The situation you are presenting is where the loads are kept equal in spite of lack of connection. Now, ordinarily the lack of connection itself presumes that the loads will not stay equal. Now, you are asking me if somehow, in spite of the lack of connection, the loads are kept equal, are you going to conclude such and such? How are you going to keep the loads equal without lack of connection?

Trial Examiner: If such an equality existed, Dr. Slepian, and instead of merely a matter of visual observation you had absolute knowledge that there was no connection, would your answer be the same?

Mr. Branch: I am sorry, may I have the question read?

Trial Examiner: The reporter will read the question.

[2568] (Whereupon the last question as above recorded was read by the reporter.)

The Witness: If I had absolute knowledge there was no connection, my answer would be the same, independent of whether the loads were equal or not. That is, if I know there is no connection, then I know that the consumption at B equals the generation at A, regardless.

Trial Examiner: Under those circumstances, would you in any case allot the consumption at B to the generation at C?

The Witness: No, I would find it convenient to allot the consumption at B to the generation at A, because I know that with a lack of connection, with no further information, I know that the

generation at A equals B, and therefore I make that allocation because I know that it would.

Trial Examiner: I think that largely answers my question.

By Mr. Wahrenbrock: *Q* Now, I want to recede a little bit from the point to which we have been carried by the concept of absolute knowledge, and get back to the world where our knowledge is a little less than absolute, and ask whether if the load B and the supply A, to which it is apparently electrically connected, are here in Hartford, and the generator C and the load to which it is apparently electrically connected is in Shanghai, China, and the amount of electric energy being supplied at the point A is continuously equal to the amount being supplied at point B [*2569*] in Shanghai, you would assume or allocate the load B to the generator C, as readily as you would to the supply A?

Mr. Branch: Wait just a minute.

Trial Examiner: I don't know whether I have your B and C and A clear in that, Mr. Wahrenbrock.

Mr. Wahrenbrock: The same as heretofore except we have put supply B over in Shanghai.

Trial Examiner: I had not understood. I suggest that the reporter read the question back.

(Whereupon the last question as above recorded was read by the reporter.)

Trial Examiner: I think you had better put the question again.

By Mr. Wahrenbrock: *Q* I wish you to take the example concerning which we have been considering, and ask you to assume that the supply A and the load B, to which it is electrically connected, are located here in Hartford, and the supply C and the load D to which it is apparently electrically connected are located in Shanghai, China, and ask you whether, if the supply A is continuously equal to the supply C, you would regard the allocation of the load B to the supply C as equally valid with its allocation to the supply A? *A* The preface to this or the preceding question talked about the actual world, and I think i. view of that preface I [*2570*] may first remark that if there is no connection

between the generator and the load in China, and the generator and the load in Hartford, the equality in those loads will not exist; unless there is some means taken to assure they will be equal, they will not stay equal. They will never be equal as a practical matter. Therefore, when you assume equality, continued equality, I must conclude there is some kind of an interconnection between those two systems, and if you will not permit the two loads to be varied independently, then as long as—I would say under those circumstances I would just have to regard that as one system with two generating systems and two loads, and I am not able in any unique way to assign either load to either generator. If I choose to assign the one load to one generator, and the other load to the other generator, it is entirely a matter of convenience. With your premise you have given me no reason of convenience to assign it to one or to the other. With your premise you are saying they remain equal, and because each load remains equal in magnitude to either generator, you deprive me of any reason for assigning that load to one generator or the other. However, I wish to emphasize the situation you have presented cannot accurately be realized without some kind of a connection between the two systems.

* * * * * * [2571]

Q I hope that I have now finished with the A and B and C and D separate circuits, and I wish to return to your earlier illustration of a line with a supply A at one end, a supply B at the other end, with a load C near the supply A and a load D near the supply B. Instead of assuming the amounts of generation and load which you assumed, I wish to change those amounts and to assume a generation of 9,000 kilowatt-hours at A, a load of 5,000 kilowatt-hours at C, a load of 6,000 kilowatt-hours at D, and a supply of 1,000 kilowatt-hours at B. I pause to ask if that is understood on all sides, before I go forward?

* * * * * *

Trial Examiner: As I understand it, Mr. Wahrenbrock, your two generators are A and B?

Mr. Wahrenbrock: Yes.

Trial Examiner: And the two loads are C, 5,000 and D, [2572] 6,000?

Mr. Branch: May the witness see this?

(Diagram handed to the witness.)

Trial Examiner: The two supplies are 9,000 and 1,000 respectively, at A and B?

Mr. Wahrenbrock: Yes.

Mr. Branch: The loads are 5,000 and 6,000?

Mr. Wahrenbrock: Respectively, at C and D.

By Mr. Wahrenbrock: *Q* Now, in this case do you say that it is impossible to assign any part of either load to a specific source of supply?

The Witness: May I ask a question?

Trial Examiner: You may.

The Witness: Is this an isolated system?

Mr. Wahrenbrock: No other connections than those shown.

The Witness: In this picture you have shown me the sum total of the generation is 10,000 kilowatts and the sum total of consumption is 11,000 kilowatts, and therefore it is a case that cannot present itself.

Mr. Wahrenbrock: All right, thank you for pointing it out. Will you change the assumption that B is a supply of 2,000 instead of 1,000?

* * * * * * [2573]

A I say that it is impossible to assign either load to either supply in any particular way in a uniquely demonstrable manner.

By Mr. Wahrenbrock: *Q* Is it possible to conclude that neither Load C or Load D could be exclusively supplied from supply B? *A* I believe that by such a statement you merely mean that the supply B is not adequate for supplying either D alone or C alone, and assuming you mean that, I agree with the statement.

Q Then we must assume that a part, at least, of both loads C and D is supplied from A, must we not? *A* Again if by that

assumption you mean merely that B is not sufficient to complete the supply, B is not large enough in magnitude to account completely for D and C, if that is what you mean, yes.

Q Well, then, in such a case it is possible to allocate at least parts of the loads C and D to a particular source of supply, is it not? *A* Yes, with the meanings that you have just given to the words, yes.

Q Now, I wish to make the further assumption with respect to the case I have just put, that the supply B constitutes the total of the connected supply in Connecticut to the C.P. 1 and C.P. 2 lines, and the loads C and D constitute loads and the [2574] total loads—

Mr. Wahrenbrock: I will withdraw that last—

Q —The load D only constitutes the total connected load in Connecticut on the C.P. 1 and C.P. 2 lines.

Mr. Branch: May we have that question reframed? There was a change there that threw me off.

Mr. Wahrenbrock: I will state it, if I may.

By Mr. Wahrenbrock: *Q* The load B constitutes the total connected loads on the C.P. 1 and C.P. 2 lines in Connecticut. The load D constitutes the total connected to the C.P. 1 and C.P. 2 lines both in Connecticut.

Mr. Branch: Well, I am still not clear as to these things.

Trial Examiner: I am not sure if there is any part of the question which wasn't completed. I would suggest that counsel starts it as a new question, so as to be sure just what is what.

By Mr. Wahrenbrock: *Q* I wish to take the hypothetical situation which we have been discussing previously, and relate it to the C.P. 1 and C.P. 2 lines by assuming that the supply B is the total connected supply.

Mr. Branch: D?

Mr. Wahrenbrock: B as in banana,—is the total connected [2575] supply in Connecticut. The load D is the total connected load in Connecticut. D as in December. I wish to assume further that the load C represents connected loads outside of the

State of Connecticut, total connected loads outside of the State of Connecticut, and A represents total connected supply outside the State of Connecticut. On those assumptions, I ask you whether it must be concluded that part of the load D, representing the total connected loads in Connecticut, is supplied from outside the State? *A* The mere attaching of designations with a geographical flavor to these quantities doesn't change the conclusion. As before, I stated that the assertion that the energy received at D arises partly in A, that that assertion which I was interpreting as being the equivalent of stating that generation at B is insufficient to supply the complete load to D. With that meaning of the statement, I can accede to it. Now, giving a geographical flavor, or, I would say that if, when you say that the energy consumption at D arises partly from generation outside the State, you mean that the generation within the State is not sufficient to supply D, if that is what you mean by it, then I agree to it.

Q I wish to refer to the diagram of the tapped transformer which you prepared yesterday on the witness stand.

Mr. Wahrenbrock: In order to do so, I would like to ask [2576] respondent's counsel if they have that diagram.

Mr. Branch: Yes.

Mr. Wahrenbrock: Would you be willing to do whatever you are going to do in the way of identifying or introducing it?

Mr. Branch: Yes. May I interrupt for just a minute?

Trial Examiner: Yes, for the purpose of identifying the exhibit.

By Mr. Branch: *Q* Dr. Slepian, I show you Exhibit 81 for Identification, which you entitled "Energy Flow in tapped transformer, signed Joseph Slepian", and I also show you another photostat which has been made which is designed to show the same thing, in perhaps a little clearer manner, on account of the difference of paper on which it was written and so forth. Does the paper which is not marked substantially illustrate what you attempted to illustrate in Exhibit No. 81 for Identification? *A* Yes, it seems to.

Mr. Branch: I ask that this sheet, at the top of which is printed

"Energy Flow in tapped transformer", be marked now Exhibit 81-A for Identification.

Trial Examiner: It may be so marked.

(The document referred to was marked as Exhibit No. 81-A for Identification.)

Mr. Branch: I now offer in evidence Exhibit No. 81-A [2577] for Identification.

Trial Examiner: Is there any question?

Mr. Wahrenbrock: It will probably be helpful in understanding the testimony which has been given, and for that reason I have no objection.

Trial Examiner: The diagram marked Exhibit 81-A for Identification will be received in evidence.

(Exhibit 81-A for Identification received in evidence as Exhibit 81-A.)

By Mr. Wahrenbrock: *Q* Directing your attention to Exhibit 81-A, I wish to ask you to explain how the watt-meter by which you say the reading of 9900 watts would be produced, would be connected? *A* It would be connected in the usual way for reading the power, so-called power in a line. The current element of the watt-meter would be placed in series with the line.

Q In series with which line? *A* With the line marked 9900 volts.

Q That is the current— *A* Yes.

Q Transformer. *A* The current element, which may be through a transformer, or may be directly to the line. In case of the 9900 volts it probably would be the transformer. And the potential element which may be through a transformer would be from the [2578] line to the ground.

Q Now, in the case of the watt-meter registering the 10,000 watt reading, how would it be connected? *A* The current element transformer would be placed in series with the 10,000 volt line, and the potential element would be connected between the line and the ground.

Q Why wouldn't you connect a watt-meter in such a circuit by

connecting the potential element across or between the lines marked 10,000 volts and the line marked 9900 volts, with the current element in series with one or the other of those lines? *A* The question I wanted to answer by the use of the watt-meter was the power as defined by watt-meter in the 10,000 volt line. When I connect that meter into that line to determine the power there, I do not know what load it is going to; I do not know the current in the 9900 volt line will have any relationship to the current in the 10,000 volt line. I am asking what is the power, what is the energy flow which seems to have been the discussion of the Commission engineers. Repeatedly, they asked what is the energy flow in that line, and the way to get that energy flow if you use the watt-meter method is to connect the watt-meter in the manner I have indicated.

Q What would a meter, a watt-meter connected as I have suggested, show? *A* I would interpret that as reading the sum of the [2579] energy flows in two lines.

Q In numerical value, what reading would it give? *A* That would be 100 watts.

Q What value does that represent? *A* 100 watts.

Q Does that represent the true-load on the 100 ohm resistance? *A* I do not understand the adjective "true".

Q Does it represent the load of 100 arm resistance? *A* It equals the energy consumption at the resister.

Q Under the conditions shown, what is the current in the lower part of the coil which is grounded? *A* You want it approximately?

Q Yes. *A* Well, I would have to stop and compute it.

Q Well, isn't it readily computable? *A* It will be approximately 1/100 of an ampere, if I haven't made a mistake in arithmetic. Approximately.

Q Wouldn't it be zero except for the charging current? *A* Yes. I revise my answer. It will be nearer to zero than a 100th of an ampere.

Q When you referred in your testimony on direct examination

to the current in the center of a conductor being under some circumstances slightly out of phase with the rest of the current in the conductor, did you have reference to what is [*2580*] generally referred to as the skin effect phenomena? *A* Yes, the same sort of thing.

Q How much would the skin effect phenomena affect the resistance of the conductors in the CP1 and CP2 lines? *A* Do you happen to know the diameter?

Q Assume that the largest cable is 0000 aluminum.

* * * * * *

Q I show the witness Exhibit 38, where the data appears which he asked for, on the CP1 and CP2 lines.

Mr. Branch: That is Exhibit 38?

By Mr. Wahrenbrock: *Q* And I direct his attention to the upper center of Exhibit 38, where those lines are shown horizontally across the page. You have the question in mind, have you? *A* Is the question completed?

Q Yes. *A* Could you tell me what the diameter is in centimeters or inches?

[*2581*] *Q* I can give you the diameter by reference. *A* I don't know what the 0000 cable dimension is.

Q I am sorry, I don't hear you. *A* I don't happen to know what the diameter of the 0000 cable is. I don't carry it in my head.

* * * * * *

Q I show the witness this handbook, and ask him if that is of assistance to him? *A* Yes, that is sufficient information for me to answer. I would estimate that the increase in resistance would be in the order of perhaps a tenth of a per cent. That is an estimate. I could give you a better estimate if I would stop and calculate the details.

* * * * * *

Q I wish now to refer to your statement near the conclusion—

* * * * * * [2582]

Q Did you refer to the reference close to the words, "Switching towers, .12", and what is that reference? [2583] *A* Well, I observed the letters 0000, and that is all that I checked. I took your statement that it was aluminum cable. Perhaps I should not have done so, but I did.

Q Would you understand the initial, "A. C. S. R." to stand for aluminum cable steel reinforced? *A* I wouldn't know it without your having told me.

* * * * * * [2584]

Trial Examiner: Does that change the witness's answer?

The Witness: Yes, if that is not a solid aluminum cable, that would very radically change my answer.

By Mr. Wahrenbrock: *Q* Well, will you state what your answer would be then? *A* I would need to know more about the construction of this cable. I would need to know how long a steel core it had, and how much aluminum, and what the relationship between the aluminum and the core was. Are these aluminum strands winding around the core? I would need to know the construction.

* * * * * *

Q Are you familiar with the convention A.C.S.R? A No, sir.

Q In the description of conductors? *A* No, sir.

Q You are not able to interpret that to me and to verify my interpretation of it, which I offered you? *A* No, sir.

Q You recognized it as a conventional representation of a type of conductor?

Mr. Branch: He already answered, and he said he didn't.

[2585] Trial Examiner: I think he said that he did not.

By Mr. Wahrenbrock: *Q* I am going to refer to the statement you made near the close of your testimony on direct examination, page 2137 of the transcript, wherein concluding an answer you said:

"One hypothesis will satisfy one thing about the origin of

power, and the other will satisfy another thing about the origin of power, and they are equally valid, but we, in our ignorance, do not know which is correct. The simple state of affairs is such that with all the information it is ever going to be possible for us to obtain, nobody is ever going to answer the question in a unique way, as to which load the power from a particular station goes to."

In the light of that statement I wish to ask you whether you are of the opinion that Mr. Miller's method of tracing flows of energy can be shown to be wrong by observable facts?

The Witness: May I ask a question?

Trial Examiner: You may.

The Witness: Will you explain to me what you mean by "showing the thing to be wrong?"

By Mr. Wahrenbrock: *Q* Don't you understand what I mean by that? *A* No, sir.

Q Do you mean to say that Mr. Miller's method of tracing flows can be shown to be invalid by physically observable facts? [2586] *A* Mr. Miller shows certain flows and draws certain conclusions, or rather, I would put it that certain conclusions may be drawn from the flows he shows. Some of these conclusions can be verified by direct observation, in one way or another. Those conclusions will be correct, and I do not think anybody will show that those conclusions are wrong. Other forms of conclusion, other conclusions from his energy flows that one might make, I believe, cannot be verified in any way, and I would say then that if one drew such conclusions from Mr. Miller's representations, and made the correctness of Mr. Miller's representations depend upon the unique validity of these conclusions, that I would say that one would have to say that Mr. Miller's pictures were wrong. That is, Mr. Miller's pictures are correct, if used correctly and to use them correctly, the only correct use you can make of those pictures is to total up the amount of power consumed or generated in various parts of the system. I can take the difference

between what the meter readings at two points in the line are and say that if there is no other connection that the energy consumed in that section of the line between the watt-meters, is given by the difference between those watt-meters, but only such conclusions shall be drawn correctly.

Q I understand that you have indicated by the answer you have just given that some of the conclusions reached by [2587] Mr. Miller in his study are not susceptible of verificarion. Is that right? *A* Of physical verification, yes, sir.

Q Of physical verification, but you don't go further and say that those are susceptible to being disapproved? *A* I go this farther. I say that other equally valid energy flow diagrams can be drawn which will agree with the correct conclusions that can be drawn from Mr. Miller's diagrams, but will disagree with those conclusions which might be naively drawn from Mr. Miller's diagrams, and in that sense I would say that Mr. Miller's conclusions are incorrect, if they are regarded as uniquely valid.

Q You speak of other conclusions equally valid. Do I understand you to mean then that as far as physically observable facts are concerned, his conclusions are valid? *A* Well, the particular conclusions I mentioned, regarding total energy consumed at a load or total energy generated at a point, those are physically observable and those are valid.

Q Are there any conclusions which he has stated in his testimony which you can say from physically observable facts are invalid?

* * * * * * * [2590]

A I would say that the fact that it is possible to construct other energy flow diagrams which agree with observable facts, but disagree with these conclusions of Mr. Miller, which were on the question, I would say that that fact requires one to drop the word "validity" in the usual sense, as applied to Mr. Miller's system.

Q Haven't you heretofore characterized the methods of rout-

ing flows as valid, so long as the total generation equalled the totalled flow? *A* Yes, I have been careful, in all those cases, I believe, to attach other sentences, so that the meaning that I was giving to the word "validity" was quite clear. There are many connotations that one must attach to the word "validity." Where I say that any method of allocating power, all these methods are equally valid, at once I am using the word "valid" in a sense that perhaps you don't use in ordinary everyday life. In everyday life a proposition is either valid or invalid, it is right or wrong. Now, here we are using a device, a method of calculation, if you like, and so on, that will give correct results when used in certain specific ways. It will lead to unverifiable results if used in other ways. Other devices of a generally similar nature will lead to the same correct results, but will lead to different unverifiable [*2591*] conclusions, unverifiable in the sense of direct physical observation. I say that these methods are equally valid, but as soon as I point out that these methods differ among themselves, it is quite clear that when I am using the word "valid" that I am not using it in the sense that I would use it in everyday life where a thing is either right or wrong. In my use of the word I have used sufficient other descriptive matters so that certain connotations which I wanted to retain in my use of the word "validity" were there. If you ask me a simple question and ask me whether the method of Mr. Miller's is valid or is invalid, I can't answer it without some discussion as to what I mean by what "validity" or "invalidity" is.

Q Well, regardless of how far away we may have been led from the assumptions of normal, everyday life, do I understand that the most that you say is that the conclusions reached by Mr. Miller in his study of these flows is that some of them are not verifiable by observable physical facts? *A* No, I say more than that. That is what I am trying to bring out. I do not merely say that some of his conclusions are unverifiable. I also state that other ways of reaching the same verifiable facts will lead to contrary unverifiable facts. Now, I think that that is an important addition.

[2592] *Q* Yes, but you have no basis to indicate any preference among the several ways of routing each of which is unverifiable by reference to observable facts? *A* If I may have preferences under different circumstances, those preferences will be dictated by other considerations than the mere generation and consumption of loads. I may be a load dispatcher and may want to say that I pick up this remote load at this nearby station, but I do that merely as a convenience of deciding how I handle my control boards.

Q There is no physically observable fact with which Mr. Miller's conclusions are inconsistent?

* * * * * *

A Yes, as I have said before, Mr. Miller's conclusions absolutely imply that they are uniquely correct. He says energy coming into this load is Massachusetts energy. He does not say "We may regard it as Massachusetts energy for the purpose of the Federal Power Commission" or something of that sort. He says "It is Massachusetts energy". Now, I say that that is inconsistent with facts, established facts, in [2593] this sense: That I can also draw energy diagrams with just as much right as Mr. Miller, and agree with all the observed facts, just as well as Mr. Miller does, and come to the conclusion that the energy going to this load is not Massachusetts energy. I perhaps won't say it as positively as Mr. Miller says, because I would be aware that there would be other ways of describing it equally validly, but the fact that I am able to do this destroys the implied uniqueness that Mr. Miller puts into his testimony.

Q If you reached such a conclusion there would be no physically observable fact to which reference could be made which would show that your conclusion was a false conclusion? *A* The conclusion that I drew, that I would draw, would be merely that this is an energy diagram that fits the observed facts. That is all I would say about my energy diagram, and that certainly could not be contraverted.

Q And in your opinion is Mr. Miller's routing of flows a routing which does fit all the physically observable facts? *A* No, if we take into account all the implications of the statement. His statement is that a certain percentage, 100 per cent Massachusetts energy, goes into this particular load. That statement is unqualified. Tied up with that statement is implied the unique validity of that statement. It implies that there is no other way of tracing energy flow that would lead to any other conclusion. I am sure that any- [2594] body reading the testimony would say that that is what Mr. Miller teaches. This, I say, is inconsistent. It does not agree with observable facts, because on the facts we can construct other energy flows which would make zero per cent Massachusetts energy go in to the particular load in question, and this other energy diagram agrees just as well with Mr. Miller's diagram, as to all observable facts. Therefore I say that in so far as Mr. Miller's testimony indicated that his method determined uniquely that Massachusetts energy entered into the particular load in question, I would say that that evidence is shown to be wrong by this possibility of constructing other energy diagrams equally valid, which do not show Massachusetts energy entering into that load.

Trial Examiner: I would like to ask a question at this point.

Disregarding entirely the verbal testimony of Mr. Miller, does the diagram or are the elements shown in the diagram uniquely disprovable?

The Witness: Now, there is shown a delivery to C. L. & P. Company, Bristol, a vertical line here. That is marked red. Below there is a caption "Electrical energy from Massachusetts". I see nowhere a statement that this is a possible energy flow. I would say that this chart claims to show actual energy flow as portrayed. Massachusetts energy being identified as Massa- [2595] chusetts energy through various connections, and up to the Bristol line. I say that that statement, implicit in this drawing, is incorrect. because I can construct another diagram with a blue line going from this plant up to Bristol, up to the Bristol line, and other

red lines, which will equally meet the power requirements at loads and generators, and show a different color, show a blue color, going up to the Bristol line. Now, the fact that I am able to construct this alternative diagram refutes what this particular diagram purports to say.

Trial Examiner: Doesn't it still leave this diagram as a possibility of not being uniquely disproved?

The Witness: That is, it does more than that. If I merely said that the particular arrangement cannot be proven, and stopped, then—

Trial Examiner: What I want to know is whether it can be disproved. That is what I am trying to get at.

The Witness: Yes, my claim is that constructing an alternative energy flow diagram equally valid that leads to a different conclusion, is a disproof.

[2596] Trial Examiner: Does that make it uniquely disprovable? Can it be demonstrated by any observable phenomena that this is not true?

The Witness: Well, it seems to me that the fact that I am able to construct a flow diagram that meets all of the observable facts in the situation, and that that flow diagram differs from this, removes the validity of the diagram.

Trial Examiner: Wouldn't the fact that this one could be drawn also remove the validity of the other one?

The Witness: Certainly.

Trial Examiner: Then you could say that neither one can be proved or disproved physically?

The Witness: Yes. What I would like to bring out is no energy flow diagram is valid for other than the purposes which we have already discussed, that are verifiable, namely, totalizing the load. As soon as you try to use any energy flow diagrams for other purposes, to mark power red or label it Massachusetts, or anything of that sort, you are going wrong, because you are stating things to be true that not only cannot be established, but which have no greater validity than contrary statements.

Trial Examiner: In other words, can neither be established or refuted?

The Winess: Yes. Quite the opposite statement is just as valid.

[2597] Trial Examiner: That answers my question. Counsel may proceed.

Mr. Wahrenbrock: I have no further questions, Mr. Examiner.

Mr. Branch: I have just one or two questions.

Redirect Examination by Mr. BRANCH.

Q Dr. Slepian, you referred in answer to recent questions on cross examination, to what a load dispatcher might do by way of attributing a certain load to a certain generator. Will you just explain what you meant by that?

Mr. Wahrenbrock: Mr. Examiner, I think that goes beyond the scope of my cross-examination.

Trial Examiner: I think that has been opened up by the cross-examination, and the question will be permitted.

The Witness: Well, we might take the situation that we have discussed several times, of a line to which a generating station A is connected at one end, and a load B at the same end, and generator C at the far end, and a load D at the far end. Now, A might be a hydro plant, we will say, and C might be a steam plant. D might be a continuous load, and B a variable load. Now, it might be the purpose of the dispatcher to try to keep A station, the hydro station, always loaded, and to use C for picking up the extra load. Now, we might be operat- [2598] ing with A connected and C disconnected. So that A might then be said to be supplying all the load, and all the load might happen to be at D. Now, let us say the load at B picks up. The dispatcher will then start bringing in his turbines at the steam station, and as he puts the—he picks up the load B at the one end of the line on the steam station C at the far end of the line. His picture is that the hydro plant, plant A, is sending energy down the line to the steady load which was always there, and that as the

additional load at B comes on, that he brings in a steam plant C to pick up that load. The station operator's picture, one that will be most convenient for him, would be that the hydro power coming down the line to the steady load, and steam power, or steam electric energy going up the line to take care of the extra load that is picking up there. Now, there is nothing wrong with that picture. It is convenient for him. It balances up the power between loads and stations. The hydro station is still generating just the amount of power consumed by the steady load. The steam station is supplying just the amount of power consumed by the regular load. So, therefore, in convenience, in following through his various operations, he thinks of electric power coming from the hydro station down the line in one direction, and steam power generated at the steam plant going up the line in the other direction, and nobody can say no to him; if he finds it [2599] convenient he is perfectly free to use it as long as he doesn't claim the energy at B is uniquely verifiable in the steam plant. As long as he doesn't make such a statement, he will get into no trouble with his dispatcher. Now, another person under the same circumstances might want to say that some of the hydro power goes to B and the rest goes into D, and that C supplies the rest of D. He wouldn't want to say that B load is part hydro, or say it is all hydro, and that the D load is hydro and steam depending on circumstances? He may do so, but that probably is a less convenient viewpoint if he happens to be the load dispatcher. That is, how you allocate the loads will just depend upon what use you choose to make of that allocation. For one purpose it will be convenient to make one allocation, and for another purpose it will be convenient to make another allocation.

Q And as far as the physically demonstratable facts are concerned, would either of those be fully valid? *A* They both equally well account for the observable facts.

Q In answer to a question on cross-examination yesterday, I think you said that at any given point in any line to which two currents had been applied, the current was the result of the com-

bined action of the two currents. Have I stated your testimony substantially correctly?

* * * * * * [2600]

By Mr. Branch: Well, can you recall—I don't seem to be able to put my finger on it, but can you recall what you did say as to current at a single point in a circuit being the result of combined action of two currents, if two currents were on the line? *A* I am sorry, I don't recall.

* * * * * * [2601]

Q On page 2161, the question was this:

> "Well, where a current then is supplied to a conductor from two sources, if we look at the point where the two conductors come together,"—and that must be "current"—"two currents coming together"—

Mr. Wahrenbrock: No, that was meant to be "conductors".

By Mr. Branch: *Q* Well, all right. "Would it be proper to say that the current in each source is the statistical average of the electrons in that conductor at that point?"

And you answered:

> "At each point in the conductor the current is the statistical average of the motion of the electrons. At each point in the conductor, I said nothing about source. I don't know what you mean by saying 'in each source'."

You were using the term "current" there as something dis- [2602] tinct from electric energy? *A* Yes. It was certainly distinct from electric energy.

Q And generally, where you used the term "current" it is distinct—

Mr. Wahrenbrock: I object to this leading method of questioning a witness on redirect examination. I think it is certainly improper to try to clarify testimony in that way.

Trial Examiner: It seems to me it is very leading.

Mr. Branch: All right.

By Mr. Branch: *Q* I will ask you, in your opinion, are current and electric energy the same? *A* No.

* * * * * * [*2603*]

Q Is the electric energy at any point the statistical average of the motion of the electrons? *A* No, not at all. The electric energy at a point in the conductors, as we have used it, is a purely postulated flow.

Q In one place in your testimony you were asked about various facilities, and among others I think you mentioned transformers as a means of transmission. Will you explain what you meant by transmission of electric energy or transmission, as you have used it in that sense? *A* I believe I was asked as to what my understanding of the meaning of the words "transmission of electric energy" was, and as I remember, my reply was that generation of electric energy at one geographical location, its consumption at another geographical location, and the intervening apparatus, among them being perhaps transformers, wires, and such things that [*2604*] are playing a part in accomplishing this purpose.

Q In using that, did you intend to draw any distinction between facilities for transmission and facilities for local distribution? *A* Oh, no. I didn't mean to go into any such special definition of the word "transmission", and "distribution". I was just speaking in general of the words "transmission of electric energy" as merely the accomplishment of this consumption at a point remote from its production, and nothing more.

Q Do you wish to make distinctions between facilities for local distribution and transmission? *A* No.

* * * * * * [*2607*]

CALVIN T. HUGHES,

a witness called on behalf of the Respondent, previously sworn, testified as follows:

Direct Examination by Mr. SMITH.

Q Mr. Hughes, I believe you stated you are the general superintendent of the Connecticut Light and Power Company, and have been since 1929, is that correct? *A* Since 1939.

Q 1939? *A* Yes.

Q Would you please state your professional training and experience? *A* I was graduated from the University of Oklahoma in 1918; received the degree of Bachelor of Science in Electrical Engineering. During the years prior to 1939, I was responsible for a great many projects throughout the Connecticut Light and Power Company property, such as engineering, construction of electrical equipment, generating stations, transmission lines, [*2608*] substations, and distribution systems. At the present time, I am generally responsible for the operating, construction and maintenance matters throughout the Connecticut Light and Power Company system. This includes the generation, transmission, and distribution of electric energy. I am a registered engineer in the State of Connecticut, and a member of the American Institute of Electrical Engineers.

Q Are you familiar in a general way with the facilities of your company, such as generating plants, transmission lines, and substations? *A* I am.

Q Are you also familiar in a general way with the electric system of the Borough of Groton, in Groton, Connecticut? *A* I am.

Q Does your company sell electricity to the Borough of Groton in Connecticut at the present time? *A* Yes.

Q Have you prepared figures showing the total energy generated and received by your company for the years 1937 through 1940? *A* Yes.

Q Will you kindly give those figures, starting with the year 1937?

Mr. Wahrenbrock: Mr. Examiner, I object. I don't see any relevancy.

[2609] Trial Examiner: I think the question may be relevant. The witness may answer the question.

Mr. Wahrenbrock: Well, Mr. Examiner, may I say if this is to show the proportion. the ratio of electric energy which is on some assumption sold in interstate commerce to the total amount of this company's, I submit that it has no relevancy whatsoever to any issue in this proceeding.

Trial Examiner: I don't think there has been any declaration as to the purpose of it.

Mr. Wahrenbrock: Aside from that, I see no relevancy whatsoever of the total figures, and on that assumed possible relevancy, I would like to be heard.

Trial Examiner: You may be heard.

Mr. Wahrenbrock: I think it is incumbent upon respondent's counsel to state what his purpose is in proving this before I answer, and to show the irrelevancy.

Trial Examiner: Well, it seems to me that the whole subject is relevant to the proceedings here. I see no reason for going into any specific offer of proof as to something which is generally relevant. The witness may answer.

A The company generated and received in the year 1937, 748,186,164 kilowatt-hours.

In the year 1938, 670,029,034 kilowatt-hours.

In the year 1939, 780,109,105 kilowatt-hours.

In the year 1940, 871,985,957 kilowatt-hours.

[2610] By Mr. Smith: *Q* Will you give us, Mr. Hughes, the ratio which the electric energy sold by the Borough of Groton to Fishers Island for the years 1937 to 1940 bore to the total of the electric energy generated and received by your company in these same years?

* * * * * * [2612]

A In 1936 it was 19/100ths of one per cent.

Trial Examiner: I don't think that is responsive to the question. I believe the question was 1937 to 1940, was it not?

The Witness: Pardon me.

A (Continuing) In 1937 it was 19/100ths of one per cent. [*2613*] In 1938 it was 21/100ths of one per cent. In 1939 it was 18/100ths of one per cent. In 1940 it was 17/100ths of one per cent.

[*2614*] By Mr. Smith: *Q* Have you the ratio for the year 1936, Mr. Hughes? *A* Yes.

Q What is that? *A* It was .19 of one per cent.

Q And for the year 1941, the total of the year, if you know, did the Borough of Groton sell to Fishers Island Farms or Fishers Island Electric Company? *A* 1941?

Q Yes. *A* No, they didn't sell. They sold for a short while.

Q Directing your attention, if you will now, Mr. Hughes, to Bristol, are you familiar with the facilities of your company located at Bristol, Connecticut, and what your company does there in connection with the purchase and distribution of power? *A* I am.

Q Does the company purchase power from the Connecticut Power Company at Bristol? *A* It does.

Q Have you had prepared figures showing the total amount purchased by your company from the Connecticut Power Company at Bristol for the years 1937 through 1940? *A* I have.

Q And you have also just given, have you not, the figures showing the total energy generated and received by your [*2615*] company for its entire system for the same years? *A* Yes.

Q And have you figured out the percentage of the amount purchased at Bristol to the total generated and received for these years? *A* Yes.

Q Will you kindly give these figures, starting with the year 1937?

Mr. Wahrenbrock: Mr. Examiner, I make the same objection that I previously made to the ratios.

Trial Examiner: The objection is overruled. It may be material to certain questions in issue.

The Witness: For the year 1937, the company purchased from

the Connecticut Power Company at Bristol 60,107,000 kilowatt hours.

Q Now, what was the ratio of this total amount purchased and generated by the company, which figures you have already given? *A* It was 8.03 per cent. For the year 1938, the company purchased 59,804,000 kilowatt hours, which was 5.94 per cent to the total generated and received.

Q Would you look again at the figure for the amount purchased at Bristol? *A* Pardon me. I was mistaken. It is 39. 39,804,000.

Q And that was what per cent of the total generated [*2616*] and received? *A* 5.94.

Q Now, for the year 1939. *A* The company purchased 55,280,000 kilowatt hours, which was 7.09 per cent of the total generated and received. For the year 1940, the company purchased 65,474,000 kilowatt hours, which was 7.51 per cent of the total generated and purchased.

Q Do the figures of the amount purchased relate only to Bristol? *A* Yes.

Q I show the witness a single line diagram marked Bristol and hand one to the Examiner, one to the Commission's counsel, and one to the reporter, and I ask the witness what this is? *A* It is a single line diagram of the Bristol Electric supply facilities.

Q When was this diagram prepared? *A* It was prepared June 3, 1941, and the latest revision is as of July 24, 1941.

Q Was this prepared under your direction or control? *A* The original preparation was not under my direction or control, but the revisions were made and corrected under my direction.

Q Have you examined this diagram, and can you state whether it correctly depicts the facilities of the Connecticut [*2617*] Light and Power Company as shown thereon, at Bristol, at the present time? *A* It does.

Mr. Smith: I ask that the single line diagram be marked as Exhibit 82 for Identification.

Trial Examiner: It will be so marked.

(The document referred to was marked as Exhibit No. 82 for Identification.)

Mr. Smith: I offer Exhibit 82 for Identification in evidence.

* * * * * * [2618]

Q Mr. Hughes, will you by reference to Exhibit 82 for Identification, if you will, describe in a general way the facilities of the Connecticut Light and Power Company at Bristol, Connecticut? *A* The facilities of the Connecticut Power Company are terminated at the outdoor steel switching structure owned by The Connecticut Light and Power Company—

Trial Examiner: I will ask the witness to speak just a little louder.

The Witness: —with the exception of certain facilities in the substation used to operate oil breakers on Bristol Mountain, Tower 474. The power purchased comes from the 66,000 volt lines of the Connecticut Power Company, which run from the South Meadow substation in Hartford to Falls Village. At Tower 474 these lines are tapped by a line about a mile and a half in length, consisting of steel towers, which run from the 66,000 volt lines to the company's station in Bristol.

Q Who owns this tap line and the switching facilities that you have referred to? *A* The Connecticut Power Company.

Q Where does the ownership of any facilities of The Connecticut Light and Power Company start? *A* The company owns the facilities located in its substation at Bristol, which is surrounded by a wire fence, starting [2619] with an outdoor steel structure, to which the lines of the Connecticut Power Company run.

Q You stated an outdoor steel structure. Are the facilities of the company at Bristol located outdoors, in the open? *A* The facilities are located outdoors and indoors.

Q Will you describe what your company does with the power which is received at Bristol? *A* We purchase the entire electric service requirements for the Bristol district from The Connecticut

Power Company. This service is taken at 66,000 volts, metered, switched, and transformed to 13,800 and 4800 volts.

* * * * * *

Q Mr. Hughes, the bus which is labeled "4.8 k. v."—there are two buses, I guess—near the lower right-hand corner of the [*2620*] diagram, and the circuit connecting it with the transformer is designated "4,800 v.". Is that the same as the 4.6 k. v. that you refer to in your testimony? *A* It is. We use that term rather loosely, 4.6 classification or 4.8, and this actually is 4.8. It is a general terminology without too much distinction made between the two. It is a class of service.

Q Does this diagram purport to show the circuits by which remote control switches, oil circuit-breakers, are operated? *A* It does not.

Q Then the omission of any circuits, or controls for oil circuit-breakers at or near tower 474 is not to be understood as meaning that there are no such circuits or that there are no such controls in the Bristol substation? *A* That is correct. The controls are there, the property of the Connecticut Power Company.

Mr. Wahrenbrock: I have no objection to the admission of Exhibit 82.

Trial Examiner: The drawing will be admitted in evidence as Exhibit Number 82.

(Exhibit Number 82 for Identification was marked as Exhibit 82 in Evidence.)

By Mr. Smith: *Q* Mr. Hughes, directing your attention to Exhibit 82, will you state what the circuits on the bottom of the map, start- [*2621*] ing with the Number 1609 on the left-hand and running to 1605 on the right-hand are? *A* I don't believe I got that question.

Trial Examiner: Read the question back to the witness.

(The question is read by the reporter.)

A They are numbers of circuit-breakers.

By Mr. Smith: *Q* What are those lines numbered "46" on the

left to Number "5" on the right. *A* Number 41, 42, 43, 44, 45 and 46 are 13,800 volt circuits.

Q And where do they run to? *A* Some of them run to the New Departure Company in Bristol, to the Ingraham Company, New Departure Forge Company, Bristol Brass Company, Wallace-Barnes Company, and a few more industrial power customers.

Q What are the lines numbered 1 to 5 on the right-hand side of the bottom of the diagram? *A* They are 4,800 volt circuits.

Q And where do they run? *A* They radiate out in several directions from the substation, supply primarily the domestic or residential customers, and commercial customers, with a few small industrials. The last is the circuit that is associated with breaker 1613 which is connected to a 1,500 k. v. a. transformer bank which steps [*2622*] the voltage down to 2,300 volts, or 2.3 k. v. It serves as street-lighting circuits and a very small amount of load in the business center of Bristol, commercial load, primarily.

Trial Examiner: That is the one which is shown on the drawing just above the 4.8 k. v. bus lines there and directly above the stamp in the lower right-hand corner?

The Witness: That is correct.

By Mr. Smith: *Q* Will you state when the facilities of The Connecticut Light and Power Company described on Exhibit 82 and located in Bristol substation, were installed? *A* About 1926, the general design for the existing substation was made. This design provided for ultimately three transformer banks, of which one was installed at about that time. It also provided for the establishment of the 13,800 volt bus and a 4,800 volt bus. These were installed in the period of 1927 and '28. The synchronous condenser was installed late in 1928 or early '29. The second transformer bank was completed and cut in operation in 1929, which completes the installation approximately as it is today, which consists of six 13,800 volt feeders and six 4,800 volt feeders, included in the latter six, of course, is the feeder which supplies the 1,500 k.v.a. transformer bank and [*2623*] the 2.3 k.v. bus which I previously mentioned, the 66,000 volt bus struc-

ture and switching equipment, together with metering for measuring the energy at 66,000 volts and certain protective equipment.

[*2624*] Mr. Wahrenbrock: Mr. Examiner, I am going to move that that answer be stricken, inasmuch as it goes back of the period of time when the witness is shown to have been with the company, as I recall it.

Mr. Smith: You say it is prior to the time he was with the company?

Mr. Wahrenbrock: Yes. Am I mistaken as to the recollection of the date?

Mr. Smith: I believe you are.

By Mr. Smith: *Q* When did you first come with the Connecticut Light and Power Company?

A December 19, 1918.

Q Who designed these facilities in this substation which you have described? *A* I did.

Q At the time of the installation and design of these facilities at Bristol substation, what, if any, other facilities were installed or designed? *A* There were other facilities installed in connection with design and construction of the substation. All circuits, that is, the 13,800 volt, the 4800 volt circuits, which originated in the substation, were revamped, reconstructed, and the voltage changed, and additional circuits added. Or, in other words, a complete system was worked out for supplying the [*2625*] territory.

Q You have stated that you supervised the design and construction of these facilities of the Connecticut Light and Power Company. Did you at that time have any objective or plan which you wished to accomplish? *A* Yes.

Q Will you state what this objective or plan was? *A* The company had purchased the Bristol property about 1926. Due to increased loads in the district, it became evident very shortly that the existing facilities were inadequate to provide proper service, and I was assigned the task of designing a complete distribution system to replace the inadequate ones, this to include all neces-

sary facilities from the point of receiving the power to the ultimate delivery to customers. This study early indicated that it would be economical to utilize two voltages. Hence, the transformers were purchased with three windings, namely, 66,000 volts, 13,800 volts and 4800 volts. The 13,800 volts would be used to supply the larger industrial loads, and the 4800 volts to supply the residential and some commercial loads. The smaller amount of load in the center of the city was retained at the prior voltage of 2300 volts. The plans had not progressed very far before it was realized that the heavy industrial loads had a low power factor, [2626] that is, required a considerable excitation current. So it was decided to install a 10,000 k.v.a. synchronous condenser and connect it to the 13,800 volt bus which supplied the larger part of the industrial load. The location of the present outdoor bus structure, transformers, and appurtenances, was determined by the following factors: First, it was necessary to maintain service throughout the construction period over the then existing facilities. Second, at that time there was a steam heating plant which occupied the space immediately south of the present brick building which houses the indoor substation. Therefore, the present location was adopted.

Q Is there anything in the design or structure of the facilities which you have described which were adopted, or which were uniquely adopted to receive energy from out of the State? *A* No.

Q Bearing in mind, if you will your objective or plan, will you state the functions performed by the various facilities of the company in Bristol, those facilities which you of course have described? *A* All the facilities are used for the purpose of distributing locally the power received from the Connecticut Power Company to the customers of the Connecticut Light and Power Company.

* * * * * * [2627]

Trial Examiner: Do I understand there is an objection?

Mr. Wahrenbrock: The answer came so quickly, I didn't get a chance to make an objection.

Trial Examiner: I thought counsel started to rise.

Mr. Wahrenbrock: * * * And I therefore am going to object to the question and move that the answer be stricken until that is done.

* * * * * * [2630]

Q Mr. Hughes, in your opinion as an engineer, bearing in mind, if you will, the explanations you have made of the functions performed by these facilities, in your opinion are these facilities used in the local distribution of electric energy?

Trial Examiner: You may answer the question.

The Witness: Yes.

By Mr. Smith: *Q* Is that true or is—I withdraw that.

Is your opinion which you have expressed applicable to all of the facilities of the Connecticut Light and Power Company shown on Exhibit 82?

A May I have the question again?

Trial Examiner: The reporter will read the question for the benefit of the witness.

(Whereupon the last question as above recorded, was read by the reporter.)

The Witness: Yes.

By Mr. Smith: [2631] *Q* Is it not true that all of the facilities of the Connecticut Light and Power Company shown on Exhibit 82 to effect voltage changes do so for the purpose of more efficient or convenient transmission of the energy so purchased?

Mr. Wahrenbrock: I would like to have the question repeated so that I can understand it.

Trial Examiner: The question will be read back.

(Whereupon the last question as above recorded, was read by the reporter.)

Trial Examiner: Suppose you state the question again.

By Mr. Smith: *Q* Is it not true that all of the facilities of the company located at this substation to effect voltage changes, do so for the purpose of the more efficient or convenient transmission of the energy so purchased?

Mr. Wahrenbrock: The question is leading in form, but I don't know that it does any harm.

Trial Examiner: If there is no objection, the witness may answer the question.

The Witness: No. Changes are all effected as a part of the function of distribution. It would be more efficient not to change the voltage from 66,000 volts, and it would be more convenient not to change the voltage if we are going to continue to transmit it. But the changes of voltage make the distribution more convenient. None of the facilities of the [2632] company at Bristol are used for the transmission of energy purchased from the Connecticut Power Company, since all of the energy purchased is immediately distributed locally.

* * * * * * [2634]

Q Mr. Hughes, can you state what the distribution center at Bristol is?

* * * * * * [2635]

The Witness: One was "receiving point" and another term, "the center of distribution". By "center of distribution" in speaking of a territory or an area or a district that is being supplied with electric service, we ordinarily mean some point at which the customers on an average were about equidistant from that point. In other words, it might be termed a center of gravity. No, it isn't a center of gravity, it is the center of the area, when you consider the load and the customers. By "receiving point" it is my understanding of that term as to where the energy is received if you purchase energy. Shall I continue?

Trial Examiner: I think that clarifies that point. Now, does the Commission counsel desire to be heard further?

Mr. Wahrenbrock: Yes, certainly, with respect to the term

"distribution center" I think that it has not been shown [*2636*] that it has any peculiar meaning on which this witness is competent to testify as to its meaning. He hasn't been drawn out by the framing of the question, as to what the particular meaning was in which it is used in the question, and further than that its materiality or relevance to any issue in this proceeding is certainly not apparent.

Trial Examiner: It doesn't seem to me that as the witness understands the center of distribution that it would be material to any issue in this hearing. Does counsel for the respondent desire to be heard further on that point?

Mr. Smith: May I ask the witness one or two questions to clarify that?

Trial Examiner: You may.

By Mr. Smith: *Q* Where would you say, Mr. Hughes, the receiving point of energy purchased by your Company from The Connecticut Power Company is?

Mr. Wahrenbrock: Mr. Examiner, I object to that question, on the ground that the best evidence of that is the contracts, which are in evidence, if as the witness has said, by "receiving point" he means the point of delivery.

Trial Examiner: I think those are shown by the contract.

By Mr. Smith: *Q* Do you know what the contract states as to point of delivery at Bristol? [*2637*] *A* Yes, I believe so. "Shall be delivered to the Bristol substation."

Q And where is the distribution center at Bristol in relation to the receiving point?

Mr. Wahrenbrock: Well, I object to that. It is the same question I previously objected to.

Trial Examiner: It doesn't seem to be material. It may have some slight relevance. With the explanation that we have had, we will permit the witness to answer the question.

The Witness: May I have that question again, please?

Trial Examiner: The reporter will read the question for the benefit of the witness.

(Question read.).

A The distribution center is very near the location of the substation which is the receiving point.

By Mr. Smith: *Q* Now, are you able to answer the question: Are the facilities of The Connecticut Light and Power Company at Bristol between the receiving point and the entrance to the distribution center, as you have defined these terms?

Trial Examiner: I don't see how you are going to place something by the entrance to a geographical point, because, as he has defined the term, that is all the distribution center is, a geographical point determined by comparison.

Mr. Smith: Very well.

[*2638*] By Mr. Smith: *Q* Mr. Hughes, can you state whether the primary purpose of any of the facilities of the Company at Bristol, as shown on Exhibit 82, is to augment, integrate or tie together the sources of power supply?

Mr. Wahrenbrock: Mr. Examiner, I don't see the relevancy of that. That has nothing to do with the case. I object to that as being immaterial and irrelevant.

Trial Examiner: I see no reason why the witness may not answer. The objection is overruled.

A No, there is only one source of power supply in the area, and that is at the receiving point, the lines of The Connecticut Power Company.

* * * * * * [*2640*]

Q Directing your attention, Mr. Hughes, to the Robertsville Winsted line as it was for the years 1927 to 1933, I ask you [*2641*] whether, at either Robertsville or Winsted there was a load center? *A* There was a load center at Winsted. There was no load center at Robertsville.

Q What was there at Robertsville? *A* There was a small hydro-electric plant.

Q And was there anything else at Winsted, directing your attention to substations? *A* There was the Winsted substation.

Q And what was the purpose of that substation? *A* To supply service to Winsted.

Q I now direct your attention to the Torrington-Winsted line for the same period of time and ask you what was at Torrington?

Mr. Wahrenbrock: Mr. Examiner, I think that is an awfully general date.

Trial Examiner: As of what date?

Mr. Smith: 1927 to 1933.

Mr. Wahrenbrock: There was probably a general store, or maybe a county seat there. That has nothing to do with the issues in this case.

Mr. Smith: I am trying very hard not to lead the witness.

By Mr. Smith: *Q* What was there in relation to electrical equipment, if you will, of the Connecticut Light and Power Company?

[*2642*] Trial Examiner: I think counsel can go that far without any danger?

A There was a substation at Torrington and a line from Torrington to Winsted.

By Mr. Smith: *Q* Was there any other type of station? *A* There was a steam generating plant at Torrington.

Q I now show you, Mr. Hughes, Exhibit 68, which purports to be a map filed by your Company as part of its power system statement for the year 1937, and direct your attention to the substations on the left of the map, listed under the classification "Transmission substations", with particular reference to the Bristol substation, and to the substations listed under "Distribution substations", with particular reference to the Winsted-East Hampton and Collins Hill substations, and ask you if you know why these substations were classified as transmission or distribution?

Mr. Wahrenbrock: Mr. Examiner, I must object to that. No basis has been laid to show that Mr. Hughes has any basis of knowledge in knowing why this map was prepared as it was prepared, or that he has anything to do with the preparation of the report or the map.

Trial Examiner: I think that might well be clarified by Mr. Smith.

Q Mr. Hughes, I believe that this report was submitted [*2643*] some time in 1938. Were you with the Company during 1937 and 1938? *A* I was.

Q And when this report was submitted, did you have any knowledge of it at the time? *A* Yes.

Q Did your duties of the Company at that time have anything to do with substations? *A* Yes.

Q Of your own knowledge, or did you have at that time knowledge of the preparation of this report? *A* I had knowledge of the preparation of the map and the information that is shown on the map.

[*2644*] *Q* Will you explain what your knowledge is? *A* The instruction on the map, that came with the form for the preparation of the map, was not specific. Therefore, in order to show the lines, the substations, an arbitrary rule was adopted which has been in practice for some time.

* * * * * * [*2645*]

Q Prior to the preparation of this map, Mr. Hughes, to your knowledge, did the company ever classify its substations for purposes other than this map? *A* There was a classification so-called, made in 1929.

Q What was that classification?

Mr. Wahrenbrock: Mr. Examiner, I am going to object to that question unless it is shown the purposes for which the classification was made.

Trial Examiner: Well, that will have to be made a part of the examination. I think possibly one question may be asked at a time.

By Mr. Smith: *Q* In your answer, will you state what the purpose of that classification was? *A* The company for a number of years prior to 1929 did not have any working classification of its substations. As a matter of fact, for purposes of operation,

all substations were and still are treated as conversion substations, without any attempt being made to differentiate as between transmission and distribution.

* * * * * * [2647]

Q I am asking you why the company classified its accounts as you have stated in 1929, and what the purpose was for so classifying them? *A* For accounting purposes. It is an arbitrary rule which was adopted, whereby all substations of 66,000 volts—

Mr. Wahrenbrock: I am going to ask if I may interrupt, because I think it appears from the statement that the classification was made for accounting purposes, and it has no relevancy to the matter under consideration.

Mr. Smith: I think that the witness is entitled to state why in 1929, the classification was adopted, and if later on this can be used as an explanation of any later classification, I think that has considerable bearing on why or why not certain classifications were used by the company.

Trial Examiner: It may be relevant. I don't know how material it is. We will permit it.

By Mr. Smith: *Q* Will you start again your answer to my question as to why and how in 1929 you classified your substations? *A* For accounting purposes, an arbitrary voltage rule was adopted, on October 21, 1929, whereby all substations of less than 33,000 volts were listed as distribution, and all substations of 33,000 volts or more were listed as transmission.

Q Now, do you have any knowledge of your own, or did [2648] you in 1937 or 1938, of why the classification on Exhibit 68 was adopted? I am now asking you, Mr. Hughes, whether you have any knowledge, and did have?

Mr. Wahrenbrock: Mr. Examiner, may it appear on the record what the documents are to which the witness has been referring, whether they are prepared by him or not, and what it is that he is leafing through?

Trial Examiner: I think the witness may state to what he has referred.

The Witness: Exhibit 68 has on it a tabulation of transmission substations.

By Mr. Smith: *Q* Let me interrupt you first, Mr. Hughes, to ask you whether you have any knowledge of your own, or did have, in 1937, or 1938, as to why the substations of the company were classified as they were on Exhibit 68? *A* Well, it was an arbitrary rule whereby all substations of 66,000 volts—

Mr. Wahrenbrock: I am going to object to a continuation of this testimony until the basis of his knowledge is laid.

Trial Examiner: I think the witness misunderstands the question. The question is as to the basis of your knowledge. It is attempted first to develop your knowledge before the main question is put. It is necessary first to establish the basis of your knowledge, so if you will confine your answer [*2649*] to that for the present—

The Witness: I am familiar with the lists of the substations that are shown on Exhibit 68, and I am generally familiar with the map and the facilities, and with how they are prepared.

By Mr. Smith: *Q* And were you in 1937 and 1938 familiar with how your company was classifying its substations? *A* Yes.

Q And how was it classifying its substations in 1937 and 1938?

Mr. Wahrenbrock: Mr. Examiner, I am going to object unless it is stated for what purpose it was classifying its substations.

Trial Examiner: That is what I understood by the question how, that he meant for what purpose. Is that the understanding?

Mr. Smith: That is correct.

Trial Examiner: With that understanding the witness may answer the question.

The Witness: The substations were classified as transmission or distribution stations.

Mr. Wahrenbrock: Now, I am going to object to a continuation of the testimony unless it is restricted and limited according to the Examiner's ruling.

[2650] Trial Examiner: The question is not what the classification was, but what the purpose of the classification was, the question how, meaning the purpose and not the manner of the classification.

By Mr. Smith: *Q* Were there, Mr. Hughes, or was there in 1937 and 1938, any purpose or purposes for which the company classified its substations? *A* Yes, there were purposes.

Q What were those purposes? *A* They were classified for accounting purposes.

Q For any other purposes? *A* They were classified for the purpose of the preparation of this map.

* * * * * * [2651]

Q Mr. Hughes, you testified that the company's substations were classified for the purposes of this map. Did you have anything to do with that classification? *A* It was a company rule that I understood.

Q And was that a rule under which you operated? *A* Yes.

* * * * * * [2653]

Q Mr. Hughes, I would now like to direct your attention to the facilities of the Company at Torrington. I believe when you were on the stand a day or so ago you described how The Connecticut Light and Power Company obtained power at the present time, and has obtained power since June 17th of this year, from the Torrington Electric Light Company. Will you describe that again, please?

Mr. Wahrenbrock: Without asking that the question be read, what period of time is involved?

Mr. Smith: June 17th to date.

A The power we received from the Torrington Electric Light Company is generated at a steam generating plant located in Torrington, in which there are four steam turbo-generators.

By Mr. Smith: *Q* Have you inspected this plant yourself? *A* Yes.

Q What is the capacity of this generating plant of the Torrington Electric Light Company? *A* 5,500 k.v.a.

Q Can you tell me the power load of your Winsted district? *A* Approximately 2,000 k.v.a.

Q Will you describe briefly the Robertsville plant of your Company at Winsted? [2654] *A* At the north end of the Winsted district is a small hydro-electric plant. This plant contains two water-wheel generators, and when water is available in the river, it is able to carry about 600 kilowatts.

Mr. Smith: I show the witness a diagram entitled "Single-line diagram, Winsted Electric Supply" and hand one to the Examiner.

Trial Examiner: Has Commission counsel seen this?

Mr. Smith: And one to Commission counsel, and ask the witness what this diagram is.

A Single-line diagram of the Winsted electric supply.

Q As of what date are the facilities on this diagram depicted? *A* July 24th, 1941.

Q And are the facilities as shown on this diagram those that have existed since June 17th of this year? *A* Yes.

Mr. Smith: Mr. Examiner, the other day when Mr. Hughes was on the stand previously, we submitted a substantially similar diagram which was marked for identification. I would now like to have this diagram marked for identification as the same number as the other diagram and withdraw the other diagram.

Trial Examiner: Well, why not mark it as an A number. It is not necessary that the other diagram be offered. It may be related to it as an A number.

[2655] Mr. Smith: I ask that this diagram be marked as Exhibit 80-A for Identification.

Trial Examiner: It will be so marked.

(Document referred to was marked Exhibit Number 80-A for Identification.)

By Mr. Smith: *Q* Have you examined Exhibit 80-A for Identification Mr. Hughes? *A* Yes.

Q And are you able to state whether or not the facilities as

shown thereon are correct as of the date from June 17th, 1941 to date? *A* Yes.

Mr. Smith: I offer Exhibit 80-A for Identification, in evidence.

* * * * * *

Mr. Wahrenbrock: On this Exhibit, I am not sure that there is anything that needs to stand in the way of its admission, if two or three small matters can be cleared up. I would like [*2656*] to ask the witness one or two questions. First a very minor matter.

By Mr. Wahrenbrock: (On voir dire) *Q* Directing your attention to the so-called 2.4 k. v. distribution bus, I would like to ask first where you get that name "Distribution" from? *A* It was just arbitrary, just an arbitrary pick-up. It has no significance particularly, as defined by that. That is the main bus in the station. That is what is intended to be there, the main bus. It is a bus from which power is distributed, and a great many feeders go off of that bus to the Torrington Company's territory.

Q Do I understand that is a designation you have applied to the bus? *A* Yes. I think it has no particular significance in my mind.

Trial Examiner: By that I understand you to mean that that is the designation by which it is known to the employees?

By Mr. Wahrenbrock: *Q* By which employees? *A* Myself and the people in our company that just have occasion to refer to this drawing.

Q You don't want to be understood as saying that the officials or employees of the Torrington Electic Light Company have designated the bus by that name? [*2657*] *A* I don't know what they designate it as.

Q Have you ever heard them call it a distribution bus? *A* I have only called it a main 2,300 volt bus or main 2,400 bus.

Q At the right-hand end of that bus the circuit that drops down to the middle heavy bus has an oil circuit-breaker and three disconnects, two of the disconnects are labeled A and one of them is

labeled B. Will you explain whether all of those circuits are located outdoors or are some of them in the station building? *A* The disconnects that are labeled "A" right underneath the word "bus"—is that where you refer to?

Q Yes. *A* They are either side of the oil circuit-breaker. They are in the yard, and following down below those, the disconnect marked "B" is inside the station, in back of the switchboard. It is the disconnect that I believe had some tubing over the blade or some fiber, something of that sort.

Q Did you finish your answer? *A* This diagram doesn't purport to show all the details of instruments, and that sort of thing. It shows the main connections for the flow of power.

Q I would like to direct your attention particularly to the disconnect marked "A" immediately below that oil switch, that oil circuit-breaker, just below the word "bus" and ask you [*2658*] to consider carefully whether there is such a disconnect. *A* May I look at my notes?

Q Yes, sir. I would like to get it cleared up accurately. *A* My notes show Yes, there is a disconnect there, and it is located out in the yard.

Q I wish to ask you whether the so-called 2.4 k. v. distribution bus is the only bus of that voltage in the Torrington Electric Light Company's substation? *A* There is a transfer bus that can be energized from the main distribution bus as shown here, and which serves as a spare connection when circuit-breakers are taken out of service.

Most of the circuits, including the one to the left, that is connected to this 2.4 k. v. has an air break switch which is similar to most of the other circuits that connect this so-called auxiliary or spare bus. There are other buses in the yards that are primarily for connection purposes, and are associated with the physical layout. Due to the fact that they are handling very heavy currents, they have had to resort to some mechanical designs there. It doesn't affect the electrical circuit as such, and which are not in-

cluded in the present electrical circuit, and therefore omitted from this drawing just for clarification.

[2659] *Q* Do I understand that this circuit leading down to the 2.4 k.v. bus from the side of the top part of the substation, marked "From Connecticut Power Company", represents a single connection to the bus, or is there more than one connection? *A* There is more than one connection to that bus. As a matter of fact, I recall five.

Q Is there any arrangement of circuits and buses by which energy from the Connecticut Power Company could, by the closing of the disconnects and circuit-breakers reach the circuit which leads to the right from the point marked "Dead end", without going through any of the disconnects and circuit-breakers shown on this diagram? *A* Yes. I referred to that. If I understand what you mean, there is an air break switch that bypasses that breaker that you referred to, which is on the left end of the 2.4 k.v. distribution bus, and that air break disconnecting switch connects to the transfer bus that I referred to a moment ago.

Q Then this diagram represents only part of the facilities by which circuits could be arranged in The Torrington Electric Light Company substation? *A* With the exception of that air break switch.

Q An auxiliary bus and substation bus and— *A* Well, the air break switch is the only connection that makes with this.

[2660] *Q* And as you said before, you haven't represented all the circuits coming from the Connecticut Power Company? *A* No, we haven't.

Q Is there now any physical difference—I will withdraw that and put it this way:

Have any of the physical facilities which were in existence prior to June 17th been disconnected or removed? *A* No, they haven't.

Mr. Wahrenbrock: Mr. Examiner, my position on this exhibit then is this: That the witness's testimony shows that it is partial. I make no point, no particular point of that as long as the record shows it is partial and what it omits.

Trial Examiner: I think in view of the fact it does show certain facilities and the record shows what facilities are not shown on it, that the exhibit is admissible.

Mr. Wahrenbrock: I would like to make one further statement.

Trial Examiner: Very well, you may do so.

Mr. Wahrenbrock: I do have a specific objection to the use of the word "distribution", which has no foundation in usage or the nomenclature of the owner of the facilities. I think that should be stricken from the diagram.

Mr. Smith: We have no objection, Mr. Examiner, to have that stricken.

Trial Examiner: All right, with the understanding that [*2661*] the reporter will strike, before marking the exhibit, the word "distribution",—and I think counsel for both sides should point out to the reporter so that she will know what it refers to—with that understanding, we will proceed to make that correction.

Has the correction been made, Miss Reporter?

The Reporter: Yes, it has.

Trial Examiner: With the correction made, the diagram is received in evidence as Exhibit 80-A.

(Exhibit 80-A for Identification received in evidence as Exhibit 80-A.)

By Mr. Smith: *Q* Mr. Hughes, referring to Exhibit 80-A, if you will, will you continue your description of how the Connecticut Light and Power Company obtains energy from the Torrington steam plant? *A* The energy when generated by the steam turbine is connected by means of the 2.4 k.v. bus through cable and an oil circuit-breaker through metering equipment, by way of conductors which span the Naugatuck River, through transformer bank located on the property of the Torrington Electric Light Company, but which is the property of the Connecticut Light and Power Company.

Q Now, with the exception of the transformer bank, who owns all the other facilities you have just described? [*2662*] *A* The transformer bank—the Connecticut Light and Power Company

own all the facilities in the small substation west of Naugatuck River, where are located the three 1,000 k.v.a. transformers, or the 3,000 k.v.a. bank.

Q And directing your attention to the diagram, the left portion where the word "West" appears, is that approximately where the Naugatuck River is—I mean, everything west of the word "west" there on the diagram? *A* No. The Naugatuck River appears between where the word "Dead end" is and the line that runs obliquely up the page and connects with what is labeled a 2.4 k.v. Near that line.

Q And then what happens to the energy when it gets up to the 2.4 k.v. transformer? *A* It is stepped up to 27,600 volts, and there are two lines that go from Torrington to Winsted, which lines are terminated on a 27.6 k.v. bus at Winsted, from which bus two 1500 k.v.a. transformers supply service to Winsted.

Q Does the company supply any customers directly from either of those two lines running to Winsted from Torrington? *A* Yes.

Q Who? *A* I will spell this name because it is—The Oneglia & Gervasini Gravel Company.

* * * * * * [*2663*]

Q I understand that you state formerly other customers were served? [*2664*] *A* Yes.

Q Can you state during what period of time these other customers were served, and how many? *A* There were—prior to, or about the time, about 1930 and prior to that time, there were other customers supplied from the line.

* * * * * * [*2665*]

Q Mr. Hughes, I will pass to another subject, and ask you if you have made a calculation of the amount of energy which your company has purchased from the Torrington Electric Light Company for the years 1937 through 1940?

Mr. Wahrenbrock: Mr. Examiner, it seems to me we have already gotten a lot of information about that. As I recall, we went

down the whole line over my objection, and got how many [*2666*] dollars it amounted to each month. Are we going to repeat that for the third time?

Trial Examiner: I am inclined to believe that the information has already been given as to certain purchases from the Connecticut Power Company. Now, is that the same purchases you are talking about?

Mr. Smith: I believe that Mr. Miller offered testimony of purchases by the Torrington Electric Light Company from The Connecticut Power Company. These are purchases by The Connecticut Light and Power Company from the Torrington Electric Light Company. This is the second step. Commission counsel has only offered testimony on the amount of purchases of the first step, that from The Connecticut Power Company to Torrington. I now want to offer evidence of the amount purchased from Torrington to Winsted.

Mr. Wahrenbrock: We had some figures that got down into dollars, as to what the value of the energy sold from The Connecticut Light and Power Company to The Torrington Electric Light Company was.

Mr. Smith: That is quite right.

Mr. Wahrenbrock: And that was based on the amounts for those same sales.

Mr. Smith: That is quite correct.

Mr. Wahrenbrock: Are we going to repeat that again?

Mr. Smith: It was sales from The Connecticut Light and [*2667*] Power Company to the Torrington Company. I want to get sales from the Torrington Company to The Connecticut Light and Power Company. There has been no evidence of this.

Trial Examiner: Counsel may proceed with the witness.

By Mr. Smith: *Q* Have you made such a calculation, Mr. Hughes? *A* Yes.

Q Will you state the amount that your company purchased from The Torrington Electric Light Company for the year 1937? *A* 3,347,600 kilowatt-hours.

Q What percentage is that of the total energy generated and received by The Connecticut Light and Power Company, which figures you have previously given?

Mr. Wahrenbrock: I object to that again, Mr. Examiner. The ratios are irrelevant and immaterial.

Trial Examiner: It may be immaterial, but it may be relevant to some matters at issue. The witness may proceed. *A* Decimal point 47 per cent.

By Mr. Smith: *Q* Is that 47/100ths of one per cent? *A* That is right.

Q Will you tell me for the year 1938 what you purchased from The Torrington Electric Light Company and what percentage this figure is? *A* 3,769,600 kilowatt-hours or 56/100ths of one per cent.

[*2668*] *Q* For the year 1939, will you give me the figures? *A* 6,033,600 kilowatt-hours, or 77/100ths of one per cent.

Q For the year 1940. *A* 6,782,200 kilowatt-hours, or 78/100ths of one per cent.

Mr. Smith: You may examine.

Cross Examination by Mr. WAHRENBROCK.

Q Is The Torrington Electric Light Company using all of its steam generators to supply the Winsted requirements now? *A* No.

Q What is it using? *A* It is using the generator indicated, 3,125 k.v.a. unit.

Q Has it been using that unit consistently since June 17th? *A* No.

Q What units has it been using? *A* I think for a short time on June 29th or thereabouts that unit was shut down for a short while and they used the 1,250 k.v.a. unit.

Q Do you know why they shut down the bigger unit? *A* I understood a bearing got warm.

Q Was that the only occasion on which the bigger unit was shut down? *A* So far as I know, yes.

[2669] *Q* Do you know whether that bigger unit was shut down from 8:45 in the morning until 10:15 in the evening on Sunday the 20th of July? *A* I didn't know that.

Q Have you heard of the necessity of replacing carbon brushes on that unit? *A* No.

Q Do you know whether on the 19th of June the Winsted switch was open for a while because of no steam? *A* May I get the memorandum?

The Trial Examiner: The witness desires to get a memorandum on the table, from which he may refresh his memory.

By Mr. Wahrenbrock: *Q* Was the memorandum prepared by you? *A* Yes.

* * * * * * [2675]

WILLIAM A. LEWIS, JR.,

a witness called on behalf of the Respondent, being first duly sworn, testified as follows:

Direct Examination by Mr. BRANCH.

Q Will you please give your name? *A* William A. Lewis, Jr.

Q What is your home address, and your business address? *A* Home address, 415 Cayuga Heights Road, Ithaca, New York; New York business address, Cornell University, Ithaca, New York.

Q What is your position? *A* Director of the School of Electrical Engineering, Cornell University.

Q How long have you held that position? *A* Since February, 1939.

Q Will you please state your technical education and experience? *A* I graduated from the California Institute of Technology [2676] in 1926 with the degree of Bachelor of Science. I continued graduate work at that Institute receiving the degree of Master of Science in 1927, and Doctor of Philosophy in 1929.

Q Excuse me. May I suggest that you go more slowly. *A* I had previously been connected with the Westinghouse Electric & Manufacturing Company in Los Angeles, from February, 1920,

and at various times during my college years. The work during that interval consisted first of drafting, and later engineering on switchboard and switch gear equipment. In June, 1929, I went to the Westinghouse Electric & Manufacturing Company in East Pittsburgh, Pennsylvania, as a central station engineer, and I continued in that capacity until February, 1939, when I joined the staff at Cornell University. At East Pittsburgh my duties consisted of investigations and studies in connection with transmission of electric power, and the protection of electric systems. These studies involved long distance transmission, power supply to electrified railways, power systems, stability and methods of protection against trouble. In September, 1936, my duties were expanded to include consulting service to the central station customers of the Westinghouse Company in the New England district, and I made periodic trips to New England at intervals of approximately six weeks. These trips were for the purpose of assisting [*2677*] engineers of the power companies in determining their needs for equipment manufactured by the Westinghouse Company, and assisting in its proper application. The Westinghouse Company manufactures and sells steam turbines, electric generators, synchronous condensers, transformers, switch gear protective equipment, and many other items essential to the development of the power system.

Q Of what technical society are you a member? *A* I am a member of the American Institute of Electrical Engineers.

Q On what committees of that Institute have you served? *A* I have been a member of the Committee on Protective Devices since, I believe, 1933; of the Committee on Power Transmission and Distribution, since 1939; and of the Committee on Basic Sciences since 1940. I have just been appointed Chairman of the Committee on Basic Sciences for the year 1941-42.

Q Are you the author of any books or publications? *A* Yes.

Q Will you mention some of them? *A* I published a book on "Symmetrical Components as Applied to Advanced Alternating Currents." There have also been published ten articles

or papers written by me alone or in conjunction with someone else. Among these were articles on equivalent circuits of power and regulating transformers, [2678] and regulating transformers in power system analyses.

Q To what extent are you familiar with the facilities of the Connecticut Power Company at its South Meadow substation? *A* I have seen diagrams of these facilities as they have existed there, which, I believe, are Exhibits 38 and 60, and I have also visited the substation.

Q I show you Exhibits 38 and 60 and ask you if those are the diagrams to which you refer? *A* Yes, they are.

Q You have also visited the substations? *A* That is correct.

Q Are you familiar with the so-called Connecticut Power lines 1 and 2 and the Hartford-Agawam lines, so-called, and the E-line, so-called, which goes to the State line in New York? *A* I have seen the diagram showing these, which I believe is Exhibit 60 and I have seen some parts, but not all of these lines.

Q Have you read the description of the facilities of the Connecticut Power Company, the Connecticut Light and Power Company, and the Hartford Electric Light Company in Mr. Thomas's testimony in this case? *A* Yes, I have.

Q And have you studied the diagram, which is 38, Exhibit [2679] Number 38? *A* Yes,

Q And have you also studied the diagram which is Exhibit No. 82, showing the Bristol substation? *A* Yes, I have.

Q And are you familiar with the fact that the so-called Hartford-Agawam line extends to Massachusetts and is therefore connected with lines which are at times connected with generating plants in Massachusetts? *A* Yes.

Q Are you familiar with the connections between the Hartford-Agawam lines and the substation at South Meadow? *A* Yes.

Q Are you familiar with the action of a wattmeter? *A* Yes.

Q What does it indicate? *A* A single-phase wattmeter has a single potential coil and a single current coil. Such a meter indicates the average value of the instantaneous product of the

voltage connected to the voltage coil, and the current connected to the current coil. It may be shown that this is also equivalent to the product of the effective value of the voltage, the effective value of the current and the cosine of the phase angle between them which is usually designated as the power factor.

[2680] *Q* You have mentioned a single-phase wattmeter. What if any other types are there? *A* There are polyphase wattmeters. On polyphase systems it is common practice to use a polyphase wattmeter which consists of two or more single-phase wattmeter elements, mechanically connected, so that the total indication is the sum of the corresponding values for each of the single-phase elements.

Q How are polyphase wattmeters usually connected? *A* They are usually connected to a three-phase circuit, to indicate the total of the product, previously described, for the entire three-phase circuit.

Q What is a watt-hour meter? *A* A watt-hour meter is a meter which integrates the indications shown by a wattmeter over a period of time, the result being indicated in watt-hours or kilowatt hours or multiples of these units, as convenience may dictate.

Q Is a watt-hour meter a device to measure the flow of energy? *A* In a certain sense, yes. I have previously described that the meter integrates the product of the voltage connected to the voltage coil, the current connected to the current coil and the power factor. Over a period of time and under certain basic assumptions this indication may be considered to represent the flow of electric energy from a point on one side of the meter to a point on the other side of the meter.

[2681] *Q* Have you read the description of the various ratchet meters in the substation of the Connecticut Power Company at South Meadow and the adjoining plant of the Hartford Electric Light Company, in Mr. Miller's testimony in this case? *A* Yes, I have.

Q And what kind of meters are those ratchet meters which he

describes? *A* The ratchet meters are polyphase watt-hour meters, so arranged that they will indicate the flow of the product I described in a single direction only.

Q Are you familiar with the log sheets used by The Connecticut Valley Power Exchange? *A* Yes, to the extent that I have examined the photostats of some of them, so as to be familiar with the way in which they are kept.

Q Have you examined the log sheet of The Connecticut Valley Power Exchange for January 15th, 1939? *A* Yes, that is one of the sheets I have examined.

Q Would any study based on the information which could be obtained from that log sheet of January 15th, 1939, showing the first nine hours of the morning, based also on the readings of any other wattmeters or watt-hour meters—

* * * * * * [*2682*]

Q Would any study based on the information which could be obtained from that log sheet of January 15th, relating to the first nine hours of the morning, based also on the readings of any other watt-meters or watt-hour meters, together with knowledge of the method of operations shown thereon during that time, together with knowledge of location of the meters and the readings made from them, conclusively show that the load of The Connecticut Light and Power Company at Bristol was served exclusively during those hours with energy generated outside of Connecticut, as for example, in Massachusetts, in your opinion?

* * * * * * [*2683*]

A No.

[*2684*] By Mr. Branch: *Q* Will you explain? *A* Where several loads are connected with two or more sources of generation, so far as I know, there is no established principle by which energy in any particular load may be identified as to its source, and I therefore do not believe it possible to definitely conclude from any watt-hour meter readings showing the resultant flow of energy, where the source of that particular load may have been.

Q Why, in your opinion, would not the readings from the watt-hour meters and the other things indicated on the log sheet be sufficient basis to be conclusive? *A* The watt-hour meters show only the resultant or net energy flow, and in my opinion it is possible for the energy to be resolved into components from different sources flowing simultaneously in opposite directions. For example, in this case, it appears that the resultant energy flow in the South Meadow station during the hours in question is from the Connecticut Power Company transformers to the Hartford 11 k.v. bus; but it also appears that during all these hours there was a substantial amount of power generated in the South Meadow station of the Hartford Electric Light Company; considerably more, in fact, in each of the hours in question than the load at Bristol. In my opinion, it is possible for the power generated in [*2685*] Hartford to flow through the transformers in question to the Connecticut Power lines 1 and 2, and to supply the load at Bristol, in spite of a greater flow in the opposite direction through the same transformers.

* * * * * *

Q On what do you base this conclusion? *A* In many cases in electrical engineering, it is convenient to consider the total current flow in a conductor as being composed of several components which, added together, give the total current. In all such cases, to my knowledge, this hypothesis properly applied leads to correct results. Consequently, many engineers definitely believe that the components of current have definite existence in the conductor at the same time. This hypothesis is not affected in any way by the fact that these components of current may be flowing in the same direction or in opposite directions at the same time. There is no physically demonstratable fact which will prove [*2686*] that these components do not physically exist. Under this hypothesis that the components of current may flow in opposite directions, there will be associated with each component of current a corresponding flow of energy which may therefore be flowing also in opposite directions at the same time.

Q Can you indicate common examples where this method of solution is regularly used in engineering practice? *A* There are several. One of the most common is the auto transformer. I will illustrate this by means of a sketch.

Q Have you the sketch here? *A* Yes. (Handing document to counsel.) Which compares the auto-transformer with the corresponding two-winding transformer.

Q You have just handed me a sketch, at the bottom of which are the words, "Auto-Transformer, alternative presentation".

Mr. Branch: I ask that this be marked Exhibit 83 for Identification.

Trial Examiner: It will be so marked.

(The document referred to was marked as Exhibit No. 83 for Identification.)

* * * * * * [2687]

Q Does that represent an auto-transformer? *A* It represents, the top of the sketch, a two-winding transformer, and in the two lower figures an auto-transformer.

Q Does it correctly represent the general features of those transformers? *A* In accordance with the usual diagrammatic representation of such apparatus.

Mr. Branch: I offer it in evidence.

Mr. Wahrenbrock: No objection.

Trial Examiner: It will be received in evidence.

(Exhibit 83 for Identification received in evidence as Exhibit 83.)

By Mr. Branch: *Q* Will you continue with your explanation, please? *A* In the two-winding transformer, as shown here in the sketch at the top of the sheet, the current in the primary winding and the current in the secondary winding are entirely separate and distinct because there is no electrical connection between the two windings.

In the auto-transformer, the two windings are combined, [2688] but the magnitudes of the current entering and leaving

the terminals may be substantially the same as in the corresponding two-winding transformer. It is then possible to consider that the primary and secondary currents flow simultaneously in opposite directions in the common part of the winding, as illustrated in the second part of my sketch in the center of the page. Actually, however, the resultant current which would be measured by an ammeter in the winding is the difference between the two currents flowing in opposite directions. Either method of representing the current in the common part of the winding leads to correct results, and it is very common to consider that these currents flow simultaneously in opposite directions in the same conductor, and there is no proof that this is not so.

* * * * * *

Q Will you mention other illustrations? *A* Another illustration commonly encountered occurs when currents of different frequency flow simultaneously in the same conductor. This is most commonly encountered in [*2689*] communication circuits, such as the telephone and telegraph, where a single wire or single circuit may be transmitting messages in both directions at the same time. At the terminals, by means of suitable filters, the resultant current in the wire is readily separated into components, and several messages completely distinguish from each other. In power circuits exactly the same phenomenon exists when the current wave form is not the desired sine wave. In such a case, the resultant current may be considered at any point, and it will have a definite direction at any instant of time. On the other hand, the usual method of engineering treatment is to resolve such a current wave into a sine wave of what is called fundamental frequency, and other sine waves of higher frequency, which are usually called harmonics. It is a well-known theorem that the fundamental and the harmonic waves may be treated in the conductor as if they were entirely independent and had no effect upon each other. It is quite common for the

fundamental and the harmonic waves to flow in opposite directions, and this method of analysis gives results in agreement with experience and test.

Q Can you give another example or illustration? *A* Another illustration of common usage is the method of symmetrical components used in the analysis of unbalanced conditions on a three-phase power system, such as is being [*2690*] considered here. In accordance with this method, whenever the currents in the three phases are unbalanced, they may be resolved into three sets of components, known as the positive sequence, the negative sequence, and the zero sequence components. The positive sequence set of components consist of three balanced currents having the normal phase sequence. The negative sequence set of components consists of three balanced currents, but in this case having the opposite phase sequence. The zero sequence set of components consists of three equal currents in phase with each other. In accordance with this analysis, the current in any phase consists of the appropriate positive sequence current components, the negative sequence current component, and the zero sequence current component, all added together to give the resultant current that would be measured in the conductor by means of an ammeter. An engineer who frequently uses this method comes to think of these components as having actual existence, and as flowing simultaneously in the conductor at the same instant. The unbalance which gives rise to these components occurs most frequently as the result of a short circuit on the system, and for such a condition it is quite common for the positive sequence component to flow in one direction in the conductor, and the negative sequence or zero sequence component to flow in the opposite direction at the same time.

[*2691*] In the same manner, if we assume that power is represented by the product of effective voltage, effective current, and power factor, the corresponding energy associated with this flow of current may also simultaneously flow in opposite directions, and the engineer who deals with this problem conceives of these

components of energy as being just as distinct as the energy associated with the three separate phases.

[*2692*] *Q* Can the sequence components of current be measured? *A* Yes.

Q How? *A* By suitable instruments which, for current measurements would consist of the usual ammeter provided with what might be called a sequence filter or segregating network which selects the proper component and discards the ones not desired.

Q You have referred to current being resolved into components. Can the same thing be done for voltages? *A* Yes, from the analytical standpoint, in exactly the same manner.

Q Can the component voltage also be measured? *A* Yes, by means of a voltmeter and a suitable network or filter designed for voltage measurement.

Q Can the corresponding energy components of the sequence currents and voltages be measured? *A* Yes, if we assume that energy flow is shown by watt-hour meter indications. Using conventional watt-hour meters provided with suitable segregating networks for both voltage and current.

Q Will the sum of the energy components, as determined by these meters, be equal to the total energy as measured by the common polyphase watthour meter? *A* Yes. In the normal or balanced three-phase system, the sum will be the same, provided the direction of flow of each [*2693*] component is properly considered. That is, the components which flow in one direction are added and the components which flow in the other direction are subtracted.

Q Are you familiar with the theorem of superposition? *A* Yes.

Q What is it? *A* It is a method widely used in the analysis of electric circuits, in which the complete solution is obtained by first obtaining several partial solutions and then obtaining the complete solution by adding together the results of the several partial solutions. In each of the partial solutions a component of current is determined in each branch of the system and the

complete current in each branch is composed of the appropriate sum of the currents found in each of the partial solutions.

* * * * * *

Q In your mind, do these components obtained in the partial solutions have actual existence? *A* They may have, although their identity is not unique. The results obtained by considering that these components have physical existence simultaneously are the same as the results [2694] obtained by any other method of solution.

Q You have already stated that you believe it to be possible for two or more currents to flow simultaneously in a given conductor and for some of these components to have the opposite direction to the remainder. If this were true, would it not follow that the energy loss in the conductor computed in accordance with this theory would be much greater than that which is actually observed? *A* Certainly not.

Q Please explain. *A* Any hypothesis, to be valuable, must be in accordance with the experimental facts. To complete this hypothesis it is necessary to consider that the loss is not due to any single component of current, but is due to the resultant current. On that basis the calculation of loss is in agreement with the calculation of loss in the conductor by any other method.

Q You have described for us several illustrations where it is common practice for the engineer to assume that the total current of a conductor is composed of two or more components, which may flow in opposite directions simultaneously. May such methods be applied to the power systems we are considering, that is, The Connecticut Power Company's system, the Hartford Electric Light Company's system in the vicinity of the South Meadow substation of the Connecticut Power Company? [2695] *A* Yes.

Q How would you apply this method? *A* When two or more sources of generation are connected to a system, it is frequently convenient in calculating the current distribution to consider each

source separately and to add the results to obtain the complete solution when both sources are in operation. By this process the current in each conductor would consist of at least two components which might be flowing in the same or opposite directions. As applied to the system you have mentioned, this would mean that the current in the Connecticut Power transformers at South Meadow Station might be considered to consist of two or more components of current flowing simultaneously.

Q Is the resolution of a given current into two or more components unique? *A* No. Several such resolutions are possible.

Q In accordance with the process you have described, when two or more sources of generation are connected to a system, is it possible to trace by meter reading the source of the energy consumed by any of the loads? *A* No.

Q Please explain. *A* Since it is possible to resolve the current into components in different ways, and these components may correspond to different possible distributions of energy, it is not possible [*2696*] to definitely state that any one distribution by any one hypothesis is any more reliable or correct than some other distribution computed in accordance with a different hypothesis.

Q Is there in practice any other process of tracing energy flow that is commonly considered, but which is not based on watthour meter readings? *A* Yes.

Q What is it? *A* A process which I might call the increment of loads theory. In accordance with this theory an increment of load is applied to the system having more than one class of generation and it is considered that this increment of load is supplied by the source of generation at which the input is increased in order to carry the increased load.

Q Does this theory depend upon meter reading? *A* No. By suitable control, an increase in load at any point of the system may be applied to any source of generation on the system capable of carrying the increase in load.

Q For what purpose is this theory used? *A* It is frequently used in dispatching the load.

Q In accordance with this method of procedure, if two or more increases in load at different points are simultaneously applied to the system and two or more generators supply greater load, can the increments be individually traced to the source of generation? [*2697*] *A* No, not uniquely.

Q Why not? *A* It is a mere matter of choice for the dispatcher or other person having control to determine which increment of load is assigned to each source of generation, and several possible choices will exist.

Q Now, in accordance with any method or hypothesis of energy flow, is it possible to determine from the readings of any type of meter connected to the facilities of The Connecticut Light and Power Company at Bristol the source of that energy which is consumed at Bristol?

* * * * * *

A No.

By Mr. Branch: *Q* Why not? *A* Energy is intangible and has no characteristic that will identify its source. If a wattmeter reading is treated as a measure of the energy present at that point, it nevertheless gives no indication as to its source.

Q You said a wattmeter. Would the same be true of the [*2698*] reading of a watt-hour meter? *A* Yes.

Q By resolving the current into components at this point in the system, is it possible to trace the source of energy which flows to the load of The Connecticut Light and Power Company at Bristol, for example? *A* No.

Q Please explain. *A* Since the resolution of the current into components can be accomplished in more than one way, the resolution is not unique, and tracing the flow of energy by one analysis is no more certain to be unique than by any other analysis.

Q I have asked you recently certain questions relating to the

load at Bristol. Would your answers be equally applicable if the questions were asked of the load of The Connecticut Light and Power Company at East Hampton and at Winsted? *A.* Yes. The answer is based on general considerations which would apply at any point.

Q At any time in which a load, or the loads of The Connecticut Light and Power Company on the C.P. lines aggregate a smaller number of kilowatt-hours than the total amount of kilowatt-hours generated at plants in Connecticut, electrically connected with those loads, is it possible to demonstrate that any of the load of the Connecticut Light and Power Company is supplied in whole or in part by energy generated outside of [*2699*] Connecticut? *A* In my opinion, no.

Q In your opinion is there any scientific basis for concluding that if two generating plants are connected with an electric system, the loads also connected with this system receive electrical energy from the two sources in the same proportion as the proportions of generation? *A* No.

Q Will you explain? *A* I have already testified that there is no means available to trace the energy delivered to any particular load under the assumption that there are more than one load and more than one source of generation sufficiently large to supply any particular load. It is therefore not possible for me to conclude that any particular load will therefore definitely be supplied in any fixed proportion from any source or group of sources.

Q Do you feel that experience in the mixing of the flow of liquids or gases in a pipe from two sources, and the intermingling of the substances which result will furnish any assistance in determining what happens to energy from two sources connected to a long electrical conductor? *A* No.

Q Why not? *A* I do not believe that the analogy applies. The flow [*2700*] of gas or the flow of water is a flow of material or discreet particles within a restricted conductor or pipe. The flow of energy is intangible and we have no definite means of

knowing that the energy actually flows at any time inside the electrical conductor. A concept which I accept provides that the energy in an electric circuit is assigned to space outside the conductor in the surrounding region, and the energy itself is in no way restricted to the physical dimensions of the conductor. In such a case it seems to me that any analogy based upon physical motion within a restricted pipe or other conductor has no significance. Furthermore, since energy is actually intangible, there is still no basis, under any hypothesis, regarding the location of the energy for drawing any analogy between the two types of flow.

Q I now come to another matter. What is the function of a two-winding transformer? *A* The function of a two-winding transformer is to change the voltage of an electric circuit to a different value, more suitable for the immediate purpose.

Q Will you describe briefly the main parts of a transformer? *A* A transformer consists of a magnetic circuit, by means of which two or more electric circuits are magnetically inter- [*2701*] connected, without any electrical connection. The simplest transformer consists of an iron core and two coils of wire wound around this core. In general the number of turns in one coil differs from the number of turns on the other coil, and the ratio of the number of turns corresponds closely to the ratio of the voltage on one side of the transformer to the voltage on the other side of the transformer. One of these coils is usually called the primary winding and the other side the secondary winding. This designation is arbitrary, but for a transformer intended to transmit power in only one direction, the coil or side of the transformer receiving the energy from the line is usually called the primary and the side of the transformer which transmits the energy beyond is usually called the secondary. Depending on the function of the transformer, either the primary or the secondary may be the high-voltage side or coil of the winding.

Q Please describe briefly the operation of a transformer. *A* Current flow will occur in the primary winding of the transformer when a voltage from an external circuit is impressed upon the

terminals of the primary coil of the transformer. This current flow carries with it a flow of energy into the transformer winding and in the transformer the energy is converted largely to electro-magnetic form which is considered to be stored in the iron core of the transformer and the space surrounding it.

[*2702*] If the secondary winding of the transformer is connected to an external load, the magnetic changes taking place in the core will induce by electro-magnetic action a voltage in the secondary coil which in turn causes a current to flow through the secondary coil and into the external load. In this action, a large part of the magnetic energy carried into the transformer from the primary winding is conducted away from the core by the secondary winding, and the energy is thereby transferred through the transformer to the load connected to the secondary.

Q In accordance with your understanding of the action of the transformer, what has happened to the energy in flowing through the transformer? *A* In accordance with my conception, the energy undergoes essentially a double transformation. As it enters the transformer from the external circuit, it is partly in electro-magnetic and partly in electrostatic form. The design of the transformer is such that the energy is converted almost entirely to electro-magnetic form in the core of the transformer, and in the secondary it is again converted, so that part of the energy flowing out is again in the electrostatic form.

[*2703*] *Q* What is the difference between energy in electrostatic form and energy in magnetic form? *A* Energy in electric form appears whenever a difference of potential or difference of voltage is maintained between two conductors. In accordance with the widely accepted basic concept, an electric field appears between any two conductors between which a difference of potential or voltage exists, and this is accompanied by a storage of energy. The basic concept universally held is that the energy is actually stored in the space between the conductors, with each volume of space absorbing a certain fraction of the total energy. The mechanism by which the energy

reaches the space, or the mechanism of storage itself, are unknown. Energy in magnetic form is associated with the flow of current in a conductor. The basic concept is that every conductor carrying current has associated with it a magnetic field, both inside the conductor and outside the conductor, in which energy is stored. Again the concept universally held is that the energy is actually distributed throughout the space, and that each unit volume of space around the conductor absorbs a certain fraction of the associated energy which is stored. Again, the mechanism of energy transmission and energy storage are not definitely known.

Q What characteristic of the transformers serves to transform the energy into magnetic form? [*2704*] *A* It is the property of the iron core of the transformer. The ability of any circuit to store magnetic energy is measured by a circuit characteristic called the inductance. When the inductance of the circuit is large, the circuit has the ability to store large amounts of energy in magnetic form. There are two properties of the transformer which increase the inductance of the winding, and therefore calls for a large amount of magnetic energy to be associated with the transformer winding. One of these properties is the grouping together in close proximity of many turns of the winding. There is a mutual action between these turns which increases the inductance. The other property is the characteristic of the iron or steel core known as permeability, which measures the ability of the iron or steel of the core to make the magnetic field very much more intense, and thereby to greatly increase the inductance and the ability of the winding to absorb magnetic energy.

Q In general terms, what is the significance of this change in energy largely to the magnetic form in the region of the transformer core? *A* We may say that the energy has thus been rendered into what might be called a very adaptable form because it can be reconverted from this form by means of a suitable secondary coil into the form most adaptable for the purpose to be served. For example, if it is desired to transmit the energy a long [*2705*] distance, the secondary winding can be designed to increase the

voltage to a very high value, and the corresponding current will be reduced to a relatively low value. It is then possible to use a relatively small conductor and transmit the energy to a remote point with relatively low losses. On the other hand, if the energy is to be used to drive a machine, light a lamp, or carry on a chemical process, the voltage may be reduced by a proper secondary winding to the value most suitable for the load. Broadly speaking, I would say that the energy inside the transformer has been converted and reshaped so as to give it new characteristics.

* * * * * *

Q How does an auto-transformer differ from what you have called a two-winding transformer? *A* In an auto-transformer, one of the windings which we may for convenience call the secondary winding, instead of [*2706*] being used independently is so connected that the voltage of the secondary winding adds or, in some cases, subtracts from the voltage impressed upon the primary side.

Q In accordance with your explanation of the transformation of energy within a transformer, a two-winding transformer, will you explain what happens to the energy in an auto-transformer? *A* In an auto-transformer, part of the energy received is transformed or converted in form, just as in the usual two-winding transformer. Another part of the energy received at the transformer is passed through without transformation, and the result is, therefore, that the energy leaving the auto-transformer has been only partially transformed instead of completely transformed as in the two-winding transformer.

Q With regard to the flow of energy, what is your understanding regarding the difference between the action of the two-winding transformer and an auto transformer? *A* In the two-winding transformer, all the energy is converted or reshaped to be more adaptable for the use desired on the secondary side of the transformer. In the auto-transformer only part of the energy is converted or reshaped to meet the desired needs.

Q For what purpose is an auto-transformer most commonly used in a power system? *A* An auto-transformer is ordinarily used only when a [*2707*] relatively small change in voltage is desired, so that only a small degree of adaptation is required of the energy received by the transformer.

Q Are you aware of the fact that at the South Meadow substation there is an auto-transformer? *A* Yes.

Q And will you explain the function, and if you know about it, the necessity for that auto-transformer at that place? *A* The auto-transformer at that station is used to alter the voltage on the lines extending to the Massachusetts line, so that the power received may be connected more readily to the 66 k.v. Connecticut Power bus. The use of auto-transformers for that purpose is rather common. In that case, I do not know definitely why, but in general the answer would be similar, and I think would probably apply. Transmission of power between two stations where the voltage must be maintained cannot always be accomplished in the desired manner without some transformation in voltage. In this case, the lines from Massachusetts bring energy into the State of Connecticut, but they must leave the bus at which the voltage is maintained to meet the conditions in Massachusetts. In order to receive this energy at South Meadow, it is necessary that the voltage be changed to the value at which the South Meadow bus must operate, in order to properly send the energy at that point to the other loads on the system.

[*2708*] *Q* From your knowledge of the particular situation there, and power systems in general, can you tell us what else happens to energy which may be regarded as flowing in the South Meadow substation in relation to energy from other sources? *A* I have already stated that in an auto-transformer energy is at least partially converted. In this case, any energy that is received from Massachusetts is partially converted before it is connected with the Connecticut Power 66 k.v. bus. On one of the 66 k.v. buses, there is an interconnection with the Hartford station, or the South Meadow station of the Hartford Electric Light Company.

There the energy from Massachusetts and the energy from Connecticut are in general intermingled in a manner that cannot be later sorted out as to source. From that point, lines connect to the various loads from which energy which cannot be traced as to source is distributed to the various loads on the system.

Q Would you say that at that point anyway all energy lost all identity as to source, even if it could be traced up to that point? *A* That is my contention.

Q And would you say that that would be so even if the readings of the watt-hour meters indicated flow in only one direction? *A* Yes. I have previously testified to the general principles regarding the possibility of simultaneous flow [*2709*] of power in both directions in any circuit, providing such a resolution meets with the requirements of the system.

Q Now, may any other device be utilized to serve the same function as a two-winding transformer? *A* Yes, although for such a purpose the transformer would certainly be considered to be the most economical and practical means of accomplishing the desired result.

Q What other device might be used for the purpose? *A* One such device is a motor generator set. The motor might be connected to the supply circuit, and would therefore receive energy in the same manner as the primary winding of the transformer. The generator of the motor generator set would be capable of supplying a load connected to its terminals, in exactly the same manner as a load connected to the secondary of the transformer; and the generator could be designed and built for the appropriate voltage, so that it could perform the same function as far as the supply of energy to the load is concerned, as the secondary winding of the transformer.

Q What happens to the energy in the process of supplying a load if the motor generator set is used as you have described? *A* My concept is that the energy is received by the motor in electrical form, and is converted by the motor into mechanical energy. It is implied in a motor generator set that the motor is mechanically

connected to the generator by [*2710*] means of a coupling, belt, gear, or other mechanical means, and the energy is therefore transmitted mechanically from the shaft of the motor to the shaft of the generator. In the generator the energy is reconverted from mechanical energy to electrical energy in order to supply the load connected to the generator terminals.

Q How does this process differ from the process employed in the transformer? *A* The difference is essentially in the intermediate process employed. As I have explained for the transformer, the energy entering the primary winding is converted to magnetic energy in the core and taken from the core by the secondary, and reconverted to electrical energy before transmission to the load. In the motor generator set, the intermediate process of conversion involves a transformation to mechanical energy instead of magnetic energy.

Q If the motor generator set were completely enclosed so that the mechanism was not observable, would it be possible to detect by means of a meter connected to the circuit whether the mechanism of transformation were a motor generator set or a transformer? *A* In my opinion, it would be impossible to determine definitely from any meter readings that the inaccessible device is a motor generator set or a transformer. From the possible meter readings considered as a whole, it would be possible to [*2711*] indicate that some of the characteristics were different from those expected of a normal transformer. But if the motor generator set were designed to perform the same function as the transformers the differences detectable from the meter readings would be matters of degree only, rather than of basic character.

[*2712*] *Q* Now, Dr. Lewis, it has been said that the passage of energy through a transformer is practically instantaneous, is that also true of a generator, whatever may be the source of power for the generator? *A* Yes. Once steady state conditions have been established, there must be a continuous flow of energy in and out of the generator, almost instantaneously.

Q And it has also been said that in passing through a trans-

former, there are very small losses of energy. What have you to say with respect to losses of energy in a generator, regardless of the source of the power? *A* The loss of energy in a generator is usually somewhat greater than in a transformer, but it is still a very small percentage of the total energy transformed or passed through the generator device.

Q You have previously stated that the ability of any circuit to store magnetic energy is measured by a circuit characteristic called inductance. If the inductance of a single-circuit remote from all other circuits is known, how may the magnetic energy stored in a circuit be determined? *A* The stored energy at any instant is equal to one-half the product of this inductance, multiplied by the square of the instantaneous current at that instant.

Q If you had two such circuits, remote from each other, which we will call circuits one and two, each carrying a current, [2713] would the stored energy of each circuit be determined in the manner you have just described? *A* Yes.

Q If the two circuits are brought into proximity with each other, would your answer still be the same? *A* No.

Q Why not? *A* Two circuits physically close together present an interaction on each other which is described by a characteristic similar to the inductance of the individual circuit, known as the mutual inductance between those two circuits. When the mutual inductance between any two circuits is other than zero, the energy stored in the two circuits for given values of current is affected by the value of the mutual inductance.

Q Under the conditions in which the two circuits are close together, how may the energy stored in the magnetic field be determined? *A* Each circuit will have a stored energy equal to the product I previously described, namely one half the product of the inductance of that circuit, multiplied by the square of the current in that circuit. In addition there will be a stored energy due to the mutual inductance, which is equal to the mutual inductance multiplied by the current in the first circuit, and by the current in the second circuit.

[*2714*] *Q* Does this mean that the stored energy, when the two circuits are close together, will be greater for the same values of current in the two circuits when the circuits are close together than it is when the circuits are far apart? *A* No, not necessarily. It may be either greater or less.

Q Why? *A* The mutual inductance may have a negative sign.

Q S-i-g-n? *A* That is correct. So that the energy component corresponding to the mutual inductance may be negative and it will then reduce the total of the energy stored in the two circuits together. On the other hand, the mutual inductance may be considered as positive and the relative directions of the current may be considered to oppose, in which case one of the currents would be assigned a negative value and under this condition the energy attributed to the mutual inductance would again have a negative sign.

Q Assuming that each of the circuits under consideration consist of a single turn or single conductor, and that the cross-section of the conductor is small in comparison to its length, what will happen if the two circuits are brought into close proximity? *A* The self-inductance of the first circuit will approach the same value as the self-inductance of the second circuit, [*2715*] and the mutual inductance will approach the same value as the two self-inductances, although a choice may exist as to whether the mutual inductance is to be considered as positive or negative.

Q If the two circuits are brought as close together as it is physically possible to do so, would it be possible at a point somewhat removed from the conductors, to determine by any magnetic means, whether the magnetic field is produced by two currents in separate circuits, or a single current, having a value equal to the algebraic sum of the currents in the two circuits, flowing in only one of the circuits? *A* No.

Q If the two circuits thus brought together were replaced by a single circuit, carrying a current equal in magnitude in every instant, to the algebraic sum of the currents which had previously been carried by the two circuits, would the total stored energy in

the magnetic field be the same? *A* It would be very nearly the same, the difference depending upon the fact that the two circuits could not be made to coincide exactly and still retain their identity, and this would produce a very slight difference.

Q Let us now return to the two separate circuits physically close together, and assume that the current in one circuit flows in one direction and that the current in the other circuit is slightly less, and flows in the opposite direction. How would the total energy stored in the magnetic field compare with the [*2716*] energy of the circuit carrying the larger current, if the second circuit were completely removed? *A* It would be very much less.

Q Why? *A* Because of the mutual effect in the two circuits that I have described. The energy attributed to the mutual inductance would have a negative sign and would subtract from the energy attributed to the inductance of the circuit carrying the larger current.

Q If the two circuits in close proximity are now brought into coincidence, so that we have in effect only a single circuit, in which the net current is now the difference between the larger current in the one circuit and the smaller current in the other circuit, flowing in the opposite direction, would there be a change in the energy stored in the magnetic field? *A* The change would be very slight, caused only by the fact that the circuits did not originally occupy exactly the same location.

Q If now we consider the two circuits again and the energy which would be stored in the magnetic field if each acted alone, how would the energy so computed compare with the energy actually stored? *A* The stored energy so computed would be very much greater, because it would neglect the energy term due to the [*2717*] mutual inductance which should be subtracted, to properly determine the total energy.

Q How do you explain this action of the mutual inductance? *A* When the two circuits are in close proximity, the magnetic field of both circuits occupies the same space and there is therefore, interaction between the two magnetic circuits, resulting in the

observed fact that the stored magnetic energy differs from the value it would have if each circuit had been considered independently and the energy for each circuit so computed, added together. In other words, two magnetic fields cannot occupy the same space without mutually affecting the energy stored in the common part of the magnetic field.

Q You have previously stated that you believe it possible to consider that two or more currents may flow simultaneously in the same conductor in the same or in opposite directions. Would you not expect that if this were so, the energy loss in the conductor would be the same as would be obtained by considering each of the individual currents separately, and adding the energy losses so determined? *A* No.

Q Why not? *A* In the first place, this would not be in agreement with experimental fact. In the second place, I have just shown [*2718*] that when two magnetic fields overlap or partially occupy the same space, there is a mutual effect between them which alters the energy stored in the field and makes it differ from the value that would be computed if each circuit were considered, or acting separately, one at a time. Two or more currents, flowing in the same conductor at the same time present a very similar problem in that the two currents are now making use simultaneously of the same conductor, and it is therefore to be expected that they would have a mutual effect upon each other which would alter the energy loss when two or more currents flow simultaneously in the conductor.

Q If you assume that there is a mutual effect between two such currents, flowing simultaneously in the same conductor, in the same or in opposite directions, would the energy loss then computed agree with the observed facts? *A* Yes.

Q How do you arrive at that conclusion? *A* Let us assume that two currents are flowing simultaneously, in opposite directions in a single conductor. The power loss due to the first current would be equal to the resistance of the conductor, multiplied by the square of the first of these currents. The power loss due to

the second current flowing in the opposite direction would be equal to the resistance of the conductor, multiplied by the square of the second current. [*2719*] The sum of these two power losses would not agree with the total power loss in this conductor observed by experiment. However, if we assume a mutual resistance, due to the common use of the same conductor directly analogous to the mutual inductance I have previously described for the magnetic circuit, we would have a mutual loss term which, by analogy, should be considered as twice the product of the conductor resistance by the first of these currents going in one direction, and by the second of these currents going in the opposite direction. Since the two currents assumed are going in opposite directions, one of them should be given a minus sign and this product is therefore negative. When this loss is added to the two losses previously computed, the result will be identical with the loss that would be computed, assuming that the two currents are no longer considered to be separate, but are considered to be combined into a single current, equal to the difference between the current assumed to be flowing in one direction and the current flowing in the opposite direction.

Q Is this method of analysis that you have just described in complete accord with your previous statements that the current in a conductor may be divided into two or more components flowing in the same or opposite directions? *A* Yes, the agreement is complete, and I therefore am [*2720*] convinced that there is no method of showing that two or more currents cannot exist independently and simultaneously in the same conductor.

* * * * * * [*2721*]

Q Dr. Lewis, in answer to one of my questions, I think you made the following statement: in answer to a question asking what happens to energy which might be regarded, which may be regarded as flowing to the South Meadow substation in relation to energy from other sources. This is your statement:

"On one of the 66 k.v. buses, there is an interconnection with the Hartford station, or the South Meadow station of the

Hartford Electric Light Company. There the energy from Massachusetts and the energy from Connecticut are in general intermingled in a manner that cannot be later sorted out as to source. From that point lines connect to the various loads from which energy which cannot be traced as to source is distributed to the various loads on the system."

What did you mean there by saying that energy from Massachusetts and energy from Connecticut are in general intermingled in a manner that cannot be sorted out as to source? *A* The two sources are connected to a common facility where the energy occupies some of the same place where the energy may be. We do not definitely know, according to my concept, whether the energy is within the conductor or outside the conductor or where it may be. But when the circuits use common facilities, they must have some joint use of the [*2722*] same facility; whether or not they are mixed together, or whether they are kept separate, we cannot distinguish.

Q I now come to another matter. Mr. Thomas in his testimony, I am referring now to page 1303, defines transmission and distribution, and in the course of that he said, on page 1303 of the transcript:

> "Transmission narrows the operation down to a group of customers so closely associated as to use common distribution facilities without the necessity of considering the element of transmission between members of the group."

I ask you whether you agree with that statement? *A* I would have a question in my mind as to what Mr. Thomas means when he says, "common distribution facilities without the necessity of considering the element of transmission".

Q Why do you say this? *A* As I see it, every circuit of any physical length must consider in its broadest sense some element of transmission, because clearly, if the load is to be supplied, the energy must be transmitted from points nearer to the source, to points nearer to the load, and ultimately to the load itself, and no

circuit can ignore entirely this concept. Even circuits within a private house must consider the element of transmission, in the sense that the size of the conductor must sometimes be increased in order to reduce the voltage drop in the line, even though such a conductor size is not essential to carry [2723] the current without injurious heating.

I would therefore qualify "local distribution" somewhat as follows: Local distribution narrows the operation to a group of customers located in contiguous territory, and involving those circuits and pieces of equipment which may or are designed to serve several customers.

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By Mr. Branch: And again, in speaking of the functions of transmission and distribution, Mr. Thomas, on page 1303 said:

> "In cases where both functions are served by the same facilities, it is considered that a facility is a transmission facility as long as a material part of its utility as measured by the requirements of design depends upon transmission of energy where distance is an obstacle."

Do you agree with that statement of Mr. Thomas? *A* I would not personally agree with it if Mr. Thomas [2724] means to imply that a facility for which a material part of its utility depends upon transmission is classified as a transmission facility to the exclusion of the possibility that it may also be classified as a distribution facility, if any material part of its function is directly associated with distribution. To me, there is no clear line of demarcation between transmission and distribution, and certain facilities might easily be classified as transmission by one engineer, and distribution by another, and I would be unwilling to ascribe to a definition which insists that all facilities are transmission exclusively, if they have any transmission function in the functional sense of the word.

Q I understood you to say, "ascribe". Did you mean "subscribe"? *A* I think "ascribe" would suit my meaning.

Q All right. Do you believe it possible to draw a complete distinction then between the terms "transmission" and "distribution" or "transmission" and "local distribution"? *A* In my opinion, these terms overlap to a greater or less degree. I therefore believe that any sharp distinction between these two terms must be arbitrary, and not of a purely engineering character. It seems to me that this question in many cases depends upon the function the designer had in mind when the facility was designed and built, and it is not possible for someone else to assign a hard and fast function [*2725*] either as transmission or distribution.

Q Have you read Mr. Thomas's description of the facilities of the Connecticut Light and Power Company at Bristol in his testimony in this case? *A* Yes.

* * * * * * [*2726*]

Q Dr. Lewis, in the light of the explanations you have made in your opinion, are the three-winding step-down transformers at Bristol, which convert from 66 k. v. to 13.8 and 4.6 k. v., facilities for transmission or facilities for local distribution of electric energy?

Mr. Wahrenbrock: I object to that question. The qualify- [*2727*] ing phrase in the light of the explanation you have made is obviously an attempt to parallel that language which was used by Commission counsel where the previous explanation had an entirely different effect from any previous explanation which has been made by this witness, unless this witness is to be understood as having adopted a considerable portion of Mr. Thomas's testimony. My fundamental objection to the question as framed, is that it does not state the purpose for which the classification or the description asked is made. I believe that the question as last framed does not restrict the question to the witness's opinion as an engineer.

Trial Examiner: It does not.

Mr. Branch: Well, I will add that, but I will state that the question which you asked and which was allowed didn't state the purpose either.

* * * * * * [2728]

Mr. Branch: I insist that the question is proper, and I will add to it:

By Mr. Branch: *Q* "In your opinion as an engineer."

Trial Examiner: With that understanding, the witness will be permitted to answer the question.

Mr. Wahrenbrock: I except to that ruling, Mr. Examiner.

Trial Examiner: An exception will be noted.

A It seems to me that this transformer, or pair of transformers, is one of those borderline cases that I referred to when I stated that a particular facility might be either transmission or distribution. It seems clear to me from the very fact that two secondary voltages are provided, that there was an attempt to subdivide the power to meet the requirements of the local customers, 13.8 k. v. for the larger industrial customers and 4.6 k. v. for the commercial and domestic customers. This to me is a distribution function.

[2729] I would certainly consider it possible that this might be a completely distribution function on the basis that the C.P. 1 and C.P. 2 lines passing the present substations are delivering power in bulk to the City of Bristol and the step-down transformers are a distribution facility in the sense that they recondition the energy supplied to the 66 k. v. winding into a form most suitable for the connection to the local customer.

By Mr. Branch: *Q* In your opinion as an engineer, in the light of your explanation, is the synchronous condenser at Bristol a transmission facility, as distinguished from a facility for local distribution? *A* If the transmission line, without the use of a synchronous condenser has such poor regulation that the power could not feasibly be transmitted to Bristol, regardless of the other loads along the line, it would seem reasonable that the synchronous condenser might be applied for transmission purposes. On the other hand, if it is found that the power factor of the load in Bristol is relatively low and that it is desired to improve the power factor, in order to minimize the voltage drop in the transformers, and to control the voltage at the substation in order to produce

more nearly constant voltage on customers' lines, it seems to me that the condenser serves [*2730*] a distinctly distribution function, and I certainly could not agree that every synchronous condenser would have to be classified as a transmission facility simply because it is a synchronous condenser.

Q In your opinion as an engineer, are the three-winding transformers, the synchronous condenser, the oil circuit-breakers and disconnect switches for the control thereof, the lightning arrestors, current transformers and other equipment in the substation at Bristol, as well as the steel structure carrying the conductors on the outdoor substation belonging to The Connecticut Light and Power Company at Bristol, transmission facilities, or facilities for local distribution?

Mr. Wahrenbrock: I object to that question, Mr. Examiner, for the same reason that I objected to the first of this line of questions.

Trial Examiner: The witness may answer in his opinion as an engineer.

Mr. Wahrenbrock: Without stating the purpose for which the classification is made?

Trial Examiner: Is the witness in a position to state such a purpose?

The Witness: Yes.

Trial Examiner: All right.

The Witness: From the standpoint of the function which the facilities perform, it seems to me that the equipment referred [*2731*] to could clearly be considered as distribution equipment. I have already explained that the two major pieces of equipment, the transformers and the condenser, might, in my opinion, serve a distribution function, and that in such cases the designer might readily have a distribution purpose in mind at the time the station was built.

* * * * * *

Q When you say "distribution" what kind of distribution do you refer to, if there is more than one kind of distribution? *A*

I am thinking in terms of local distribution to the customers in the immediately adjacent territory of Bristol.

* * * * * * [2732]

Q Would you consider any line in Bristol which went from the substation to a single customer right in the City as a facility for local distribution or a facility for transmission? I am asking your opinion as an engineer, according to the function it serves.

* * * * * *

A As I understand it, the substation at Bristol is very near to the load center of that area and local lines from a substation at the load center to adjacent customers would certainly, in my opinion, be considered as a distribution facility.

* * * * * * [2733]

Cross Examination by Mr. WAHRENBROCK.

Q I direct your attention to Exhibit 82, and ask you if you have examined that exhibit before? *A* I have seen it, yes, sir.

* * * * * *

Q I show you the copy of the Exhibit 82 identified by the reporter, and ask you if you are familiar with that exhibit? *A* I have seen this diagram before, yes, sir.

Q Will you point out, indicate where the synchronous condenser at Bristol to which you have referred is located on this diagram? *A* It is in the lower left-hand corner connected by means of a line through an item which I recognize as a circuit-breaker marked 1629 to the 13.8 k.v. bus.

Q And how is it identified. What kind of a symbol? *A* It is a round circle, with the letter "C" inside, and nearby are the words "10,000 k.v.a., G.E.".

Q Now, in the normal operations of the facilities of the Connecticut Light and Power Company at Bristol, what effect if any, does that synchronous condenser have on the current or voltage in the circuits which lead from the 13.8 k.v. bus [2734] to

the customers? To simplify that question, I will divide it, and ask you what effect does it have on the current in those circuits? *A* The synchronous condenser affects the outgoing circuit only indirectly by having an effect on the voltage which is applied to those circuits, and therefore with the given load connected to them, the current would change as the voltage changes.

Q Does the synchronous condenser have any effect on the currents in the outgoing circuits? *A* As I think I tried to make clear in the previous answer it affects the magnitude indirectly by affecting the voltage which is applied to those circuits.

Q Now, when you say the voltage which is applied, what voltage, voltage in what circuits do you refer to? *A* I am referring to the voltage of the 13.8 k.v. bus which is connected to the outgoing circuits that are shown at the bottom of the diagram in the exhibit referred to.

Q Will you explain the method by which the synchronous condenser affects the voltage in the bus and the outgoing—did you say outgoing or incoming lines? *A* I said outgoing, as I remember, from the 13.8 k.v. bus.

Q Will you explain how the synchronous condenser affects the voltage in the bus and the outgoing circuits? [2735] *A* The synchronous condenser supplies what is ordinarily spoken of as a leading component of current which is added to the current in the outgoing feeders to constitute the total current received from the 13.8 k.v. winding of the transformer. The transformer, in common with every other electrical circuit, has an impedance. The voltage drop through the impedance, and the phase angle it makes at the terminals of the transformer, depend upon the magnitude and phase angle, or power factor, of the total current which flows through the transformer. The result is therefore that when the current is altered or supplemented by the action of the condenser, the power factor of the resultant current in the transformer winding is changed, and the voltage in the transformer, or I should say the voltage drop in the transformer, is thereby altered.

* * * * * *

Q Is the voltage drop in the transmission lines leading to the transformer also altered? [2736] *A* Yes, of course. The voltage drop in any part of the circuit that is affected by the current is altered to a greater or less degree, depending on the impedance.

Q And what is the effect—first, let me ask what is the alteration in the voltage drop due to the operation of the condenser? *A* The voltage drop, if I may speak in vector terms, is a vector whose magnitude is the product of the magnitude of the current and the magnitude of the impedance. Starting at the generating point, if you wish, voltage drop occurs in every element of the circuit, and the vector must be subtracted for the voltage drop corresponding to each element traversed. The angle and the magnitude of the vector voltage drop affect the result that will be obtained after the subtraction has been completed. I may say, therefore, that the condenser affects both the magnitude and the phase angle of the voltage drop, and therefore affects the resultant voltage at every point along the system to some degree from the generator to the point at which the condenser is connected.

Q When you say "affects", is that effect to raise or lower the voltage? *A* In accordance with what I have just assumed, that the condenser was supplying a leading component of current, the effect would be to raise the voltage along the way. On the other hand, every condenser can be operated to provide lagging [2737] current to some degree at least, usually not more than one-half of the leading current, and under that condition the voltage drop may be of sufficient phase angle and magnitude that the voltage is reduced.

Q Do you know how, as a matter of fact, the synchronous condenser at Bristol is operated? *A* Not from actual observation, but I have never yet seen a synchronous condenser which did not operate under both conditions at certain times of the day, depending upon the hours and the load of the system.

Q When a condenser is operating at full load, how is it normally operated? *A* It is normally operated in the sense that I

have described as leading, that is, it tends to raise the voltage at the point where the condenser is connected, in a normal power system.

Q Now, when the condenser is so operated as to supply a leading current, and as I understand you to say, such operation results in raising the voltage on the transmission line, what is the effect of that rise in voltage on the transmission line over what it would be otherwise? *A* I don't believe I can ascribe any particular effect to it, other than the fact that it transmits a load of slightly different character from what it would otherwise have done.

Q Is the capacity of the transmission line to transmit [2738] electric energy greater with the voltage so raised over what it would otherwise be? *A* It may be. I think it is possible to show that if a condenser were operated at full load under certain conditions, the ability of the line to transmit power might actually be reduced. The line will transmit for a given amount of current in the conductor the greatest amount of power when the power factor of the energy being transmitted is at unity. If a condenser has greater capacity than to bring the power factor of the resultant load to unity, the current might be leading, and the ability of the line to transmit, subject to the fact that the current would not exceed a certain value, would actually be less under that condition than at unity power factor.

Q Actually, in normal operation, how are such condensers operated at full load? *A* It depends upon the system. Largely upon the length of the transmission line. For long lines, such as those existing in the West, it is found desirable to operate the condenser so that the power factor at the receiving end of the line is considerably leading. That is, there is more reactive current in the leading direction than necessary to reach unity power factor. As the length of the line, which of course is a characteristic of its impedance, is reduced, there is a tendency to reduce the amount of condenser capacity so that the load current supplied is more nearly at unity power [2739] factor.

Q Under the conditions prevailing at Bristol, how would a synchronous condenser normally be operated at full load? *A* I do not see that that question can be answered from consideration of the Bristol load alone. This line to which the Bristol substation is connected, or pair of lines, is connected to a number of other loads, and to at least two generating stations. The operation of the condenser normally would depend to some extent at least on what is the normal practice, or what is the operation at the particular time of the other stations connected to that circuit.

Q As a matter of fact, isn't the Bristol condenser operated to raise the voltage on the transmission line? *A* It would normally be, at times of heavy loads. I would expect that at light load, the load on the condenser would be reduced to a small amount, or may be made lagging reactive.

Q Well, when you said that the current in the outgoing circuits from the 13.8 k.v. bus was affected by the operation of the condenser due to the increased voltage, were you referring to this increased voltage to which you have just referred? *A* I was assuming that that was the case, that the condenser was being operated in such a direction, or such a manner, [2740] as to increase the voltage, since that would normally be the function that you would wish to perform at times of heavy loads.

Q I understood you in your direct examination to refer to a load center at Bristol. What did you mean by load center? *A* Load center is a term which is used to define approximately the geographical or electrical center of an area which is to be supplied.

Q And where is the load center in Bristol? *A* I cannot define it exactly. It would change from time to time, and the designer of the station or of the system would endeavor to locate a station as near as possible to where he expected the electrical center of the system to be. By electrical center, I would mean that if there were expected to be two loads at opposite ends of the town of approximately equal magnitude, then the load center would be at the point half way between. If the load at one end were greater,

and the load at the other end were smaller, the electrical center would move toward the greater load. With a number of loads expected, the process is difficult to apply exactly, but would be applied approximately, and then the effort would be made in general to locate the station as near as possible to where that point was estimated to be.

Q Do I understand that you have by personal study determined where the load center at Bristol is located? [*2741*] *A* No, sir.

Q Have you studied any data which locates that load center? *A* Not exactly, no, sir.

Q Do you know whether all of the customers served by the Connecticut Light and Power Company from its Bristol substation are located in contiguous territory? *A* It is my understanding that the longest line leading from this substation is approximately 4.2 miles long, and that that is one of the 4 6 k.v. circuits. I would consider that contiguous territory.

* * * * * [*2742*]

Q Have you actually viewed the territory to ascertain whether the areas in which the customers are served are contiguous to each other or whether there are intervening areas in which customers are not served? *A* No, sir, I have not personally viewed it. I have heard the matter discussed and have listened with that point in mind.

Q Then your statement with respect to contiguous territories is not based upon your personal study or knowledge? *A* It is based only on the general discussion of that area which I have been listening to since I was called to serve on this case.

* * * * * * [*2745*]

Q How do you describe an electric current? *A* An electric current is a physical phenomenon observed by its other manifestations. It may flow in a metallic conductor or in a gas, or a liquid. In all cases, an electric current produces in its neighborhood a magnetic field which will affect magnetic material. It was observed by its effect upon a compass needle, in the neighbor-

hood of a wire carrying what we have come to call an electric current.

Q Now, what is the physical phenomenon which is the electric current? *A* I don't believe that it is definitely established exactly the physical phenomenon that takes place, but it is fairly well established that all matter is made up of particles called atoms, and that the atoms are subdivided further into smaller particles, consisting first of a nucleus, considered [*2746*] to be at least near the center of the atom, and the nucleus is surrounded by a group of negatively charged particles in the sense we have described them, called electrons. In certain substances the electrons are attached rigidly to the nucleii, and are detached only under the effect of very strong forces. In certain other materials, notably the metals, it is the conception that the electrons are relatively free to be detached from the atoms of which they may originally have formed a part, and to be subject to motion. The motion of the electrons constitutes the electric current. The electrons, as the present theory is believed, or states, are moving in all directions more or less indiscriminately under the effect of electric forces. The net flow of electrons is somewhat greater in one direction than it appears to be in the other, and we say that we have an electric current flowing in one direction.

Q What is this electric force that you refer to? *A* I think we will have to begin by discussing the constituents of matter. As I have stated earlier, matter is composed of discreet particles called atoms, comprising the nucleii, and the electrons surrounding them. When the electrons and the nucleii are separated, there appear forces tending to restore them. In the region where this separation has been accomplished, we have what is known as an electric field, and in this region any other negative or positive particle would be acted upon by a force. That is what I mean by [*2747*] electric force.

Q Is that the same as electromotive force? *A* No, it is not. Electromotive force is something quite different.

Q What is electromotive force? *A* Electromotive force is one

example of voltage, so that I think I will have to first tell you what I mean by voltage. In any electric field which I previously described, there will be forces at the points of the field. If you are to start with a unit charged positive particle, and move it against those forces from one point to another, you will have to do work, and the work necessary to move a unit charged particle from one point to another is called the difference of potential, or the difference of voltage between those two points. An e.m.f., or electromotive force, is a particular kind of voltage. It is used loosely in electrical engineering in the sense that sometimes a voltage is described as an electromotive force by some people, and other times it is described as a voltage due to mutual induction, or something of that sort. The general distinction that I have is that an electromotive force is a voltage due to something more or less external to the particular circuit in which the voltage you are discussing appears. I may further characterize it this way. In a battery, the difference of potential arises from [2748] chemical action, and we say that that is a chemical electromotive force because the chemical properties of the battery are somewhat distinct from the circuit in which that voltage tends to produce a current. In a generator, the voltage generated by the action of the rotating field, if you are considering the usual alternating current generator, is considered by many to be an electromotive force because the field which is producing the voltage is external to the circuit in which the electromotive force is being produced. In another analysis of generators, we may say that the voltage is produced by mutual inductive action between the field and the armature winding of the generator, and in that sense it would not be an electromotive force, because its two circuits are magnetically coupled together, and the voltage is due to magnetic action, so that in that sense, the electromotive force in not precisely defined, but is in a sense a type of voltage which is essentially produced by something external to the circuit in question at the time.

Q Is current the result of the application of voltage? *A* Current cannot flow without the application of one or more voltages.

There may be one voltage, or there may be several voltages in any single circuit, and current is the result of the application of all of the voltages which are present in the circuit in which it flows.

Q Is that true if we have two voltages separately con- [2749] tributed to a particular conductor there is one current from the application of those two voltages separately contributed? *A* In order to answer that, I think it is necessary to define more precisely the circuits. If we have only a single circuit, and the voltages in question are in series in that circuit, there would be a single resultant current flowing in the circuit. Whether you said it was a single current, or two separate currents flowing as a result of two separate voltages would be a matter of discussion.

Q In any case, the current in a conductor is the excess of the electrons moving in one direction over the electrons moving in the opposite direction? *A* That is my conception, yes.

Q Would you speak of that excess as a net, or a resultant of the movement of all of the free electrons in the conductor? *A* That is my conception, yes. They are moving. With the conductor carrying no current, they are moving in both directions, in equal numbers statistically. When the current flows, there is an excess of flow in one direction over that in the other.

[2750] *Q* Well, now, when we have two sources of supply of current to a single conductor, how would you explain the movement of electrons in that conductor as differentiated from the condition where there is only one source of supply of current to the conductor? *A* In the conductor where both currents are presumed to be flowing, there will be a net flow of electrons which does not distinguish as to whether it is a single current or two currents or more currents which make it up. I can't identify the electron as belonging to a particular current and yet I cannot say that it does not.

Q They are indistinguishable? *A* As far as I can see they are indistinguishable.

Q They do not preserve any relation with reference to each other, any physical or spacial relation with reference to each other?

Mr. Branch: I object on the ground that it isn't quite clear what "they" refers to.

Trial Examiner: Clarify what you mean by that.

Mr. Wahrenbrock: The electrons moving in the conductor as a result of the supply of current from two sources.

* * * * * * [2751]

A I cannot see that they maintain any fixed spacial relations. Does that answer your question?

By Mr. Wahrenbrock: *Q* I am interested in ascertaining whether as that movement continues through a conductor there are any laws governing the relation of those movements of electrons to each other? *A* The relative motion of the electrons at any particular point in a conductor depends upon the electric force at that particular point in the conductor, and that is the resulant effect of all the electric charges in any part of the circuit whatsoever. So that as far as any particular point is concerned, I don't see that you can say anything about an attachment of that electron to anything except the whole circuit, and not to its immediately adjacent neighbor.

Q Well then, when you have two sources supplying current to a conductor, do I understand that you would say that the resultant current in the conductor is the resultant of both sources, as though both sources are mixed in the conductor; you cannot distinguish or attribute the resultant current, or any part of it, to one source or the other? *A* I don't see that you can make such a statement as that. Let me illustrate what I mean. Let us suppose that we apply one source of potential to the conductor alone. The effect of that will be to cause a migration of electrons in the proper direction along the conductor, in accordance with [2752] that electromotive force or source of voltage, whatever it may be. That does not tell us at all that electrons did not go in the opposite direction; in accordance with the theory I have explained, which we believe to be true, there are still electrons moving in both directions, and it is the net excess of flow in one direction as com-

pared to the other which constitutes the electric current. Now, let us suppose that we independently apply another source of potential to that conductor. There will be another mass migration of more electrons, in one direction, than there is in the other. If both sources of potential are applied simultaneously, there will be an increased motion of electrons net in one direction if the two currents are tending to flow in the same direction than there was before. The net motion of electrons is the same, whether you consider that what you have got is one current or whether it is two separate currents that you previously had.

Q Well, you don't have a picture, do you, of two separate streams of electrons moving in the conductor as a result of the two separate potentials applied simultaneously? *A* They are not separate, inasmuch as they use the same space within the conductor.

Q The electrons which are moving predominantly as a result of one source of supply—

* * * * * * [2753]

Q (Continuing) —are moving in the same areas of the conductor as those which are moving as a result of the current flowing from the other source of supply? *A* The current occupies the entire conductor. We don't know just exactly the constituents of the matter that tell us how it occupies the conductor, but at least we know that if the current flows in the conductor, it spreads out to occupy the entire conductor. Any other current flowing in the same conductor would do likewise.

Q Well, I find it difficult to get a picture of just what the action of these electrons is. Is it reasonable for me to picture two flows of vibrating or drifting electrons passing along side by side without mixing with each other? *A* It is awfully hard to give a picture of something that we know so little about, but we have this concept. The electrons certainly do not move as fast as the current is presumed to flow, approaching the velocity of light. The electrons drift along the conductor very much more slowly.

Now, whether the same electrons drift faster, or other electrons drift along together with them, or whether still [*2754*] other electrons are detached from the atoms and flow as a result of the second current that you are referring to, we have no means of knowing.

Q Well, they are then, as I get the picture, whether they behave in one way or the other, their actions are mixed? *A* Well, in certain sense I would say they have to be. They are electrons in the same conductor, within the same dimensions, they are spread over the entire cross-section, so that they are in the same restricted volume at the same time, so that in that sense certainly they must be mixed.

Q Depending on these several theories that you have suggested, that they may not move as fast as the speed of light and they may drift or they may vibrate or one may affect successive ones, that is taking place helter-skelter? *A* That is my conception of it, yes.

Q In your direct testimony, you have shown electric energy as being associated with current. Will you explain what you mean by that? *A* If we can segregate a little portion of the circuit, in order to talk about it, in which at least one conductor goes in and one comes out, if there is current flow in the conductor going in and a corresponding current in the other conductor flowing out, and if there is a difference of voltage between those two conductors as they enter the region, we can find by experiment that energy must enter that region coming from [*2755*] an outside source. It flows when the current flows. That is, we find that energy comes in when the current is flowing and the voltage is maintained; it stops when the current is stopped. We don't know how it gets there, except that I have just told you the experimentally observed fact.

We therefore say that in the face of those facts, when the current flows and the potential is maintained, there is a flow of energy electrically from one side of the region to the other side of the region where our measuring instruments are located.

Q Well, is electric energy something that has shape? *A* No.

Q Or form? *A* Not that I know of.

Q Well, what do you mean when you speak of electric energy as being reformed or reshaped? *A* As I have told you, electric energy must be accompanied both by the presence of voltage between the conductors in question and the presence of current within the conductors in question. Under those conditions, electric energy is present. However, if you change the voltage of the current, the form of that energy and its ability to do work is not the same as it was before.

Q Well, what do you mean by "form of the energy"? *A* Well, I have just described the energy as being char- [2756] acterized by the presence simultaneously of voltage and current, so that the three, the energy, the voltage and the current, are definitely tied up together. Without the three of them, you do not have a complete system.

Now, if the voltage is changed--and let us say it is increased—the current is proportionately decreased in order that you may have the same total amount of energy.

We may therefore have the same amount of energy and yet have a different voltage and a different current, the three being tied up together, and when voltage and current have been changed from their previous form, I say that the energy has been reshaped.

Trial Examiner: Were you through with your statement?

The Witness: Yes.

Trial Examiner: Do I understand you to mean in that that the amount of energy does not change?

The Witness: Well, I had to assume something constant in order to talk about it. I said, "Let us assume" or intended to say "Let us assume"—that we had the same amount of energy and changed the voltage. Then if we changed the voltage the current must be proportionately changed in the opposite direction, in order that the energy should remain the same.

Trial Examiner: Isn't that what happens in the case of a transformer, that the amount of energy does remain the same?

[2757] The Witness: Except for the losses within the transformer.

Trial Examiner: Except for the transformer losses. Then you could say, could you, that except for the transformer losses the product of the voltage times the current, times the power factor in the primary, would be equal to the product of the voltage times the current, times the power factor in the secondary?

The Witness: That is correct.

Trial Examiner: That answers my question.

By Mr. Wahrenbrock: *Q* And do I understand that when you speak of reshaping or reforming, you simply mean that the energy remains the same except for transformer losses, the ratio of voltage to amperage varies? *A* Right.

Q And is that the whole of what you meant by reshaping or reforming electric energy? *A* Well, the concept that that implies. For example, let us assume that we have a lamp that is to be supplied. We also have an electric line nearby which, let us say for the purpose of making it definite, is a 13,800 volt line. Energy is available in that line, yet we know that if we connected the electric lamp directly to that line it would not operate properly. We then have to do something to the available electric energy in [2758] order to make it adaptable to the lamp that we are going to use it with. In that sense we have altered its form, so that it will apply properly to the electric lamp with which we wish to use it.

[2759] *Q* Does the ordinary power transformer do anything to voltage or current or to electric energy which can't be undone by another ordinary power transformer? *A* Except for losses, certainly not.

Q You could always, except for losses, restore the current to the original current, or the voltage to the original voltage? *A* That is correct.

Q Approximately what percentage of the full load output of a commercial power transformer is the amount of exciting energy stored in the core of the transformer at the instant of the maximum

storage? *A* I don't believe I could answer that without a calculation. The net amount which may appear there, total at any particular point, or any particular time, I should say, is probably less than the full load output of the transformer.

Q Would it be in the order of two per cent? Would you like to make the calculation with a piece of paper? *A* If you wish.

* * * * * * [*2760*]

The Witness: That question as you have phrased it cannot be answered, because energy which you have asked for is measured in units of energy, and the output of the transformer is measured in units of power. However, may I suggest that I try to answer that question by expressing the ratio of the reactive power in the transformer corresponding to the energy storage. Would that be satisfactory?

By Mr. Wahrenbrock: *Q* Well, I think if my question is modified so as to be limited to one cycle, it will be susceptible to an answer, would it not? *A* I would have difficulty with it because the energy stored at an instant is an instantaneous phenomenon, and does not apply for a full cycle. The output of the transformer is a power rating which applies at all times.

* * * * * * [*2761*]

Q What I wish you would compare is the amount of energy stored in the core at the moment of its maximum storage, with the amount of the output of energy of the transformer during the cycle? *A* I think in those terms that I have material enough in mind that I can answer. For the average power transformer, I would give a figure of approximately eight per cent stored in the transformer of the output.

Trial Examiner: By that you mean the output of one cycle?

The Witness: In the corresponding interval of time, yes.

By Mr. Wahrenbrock: *Q* Is the energy stored in the core of the transformer limited to the exciting energy? *A* I didn't intend to mean it to be so. In the usual description of a transformer, we speak of the exciting current, [*2762*] which represents the nor-

mal magnetic path, and we also speak of the leakage reactant, which includes the other paths outside of the core of the paths for magnetic flux, outside of the core of the transformer, and energy is certainly stored in that part of the transformer as well as in the core itself.

Trial Examiner: Do I understand the eight per cent to which you refe red is the amount stored in the core or in the transformer as a whole?

The Witness: I intended to mean the transformer as a whole.

By Mr. Wahrenbrock: *Q* What is the current in the primary at no load as compared with full load, in the ordinary well designed commercial power transformer? *A* By that I interpret your question to mean you wish to know the ratio of what is normally called the exciting current to the rated current of the transformer. On a typical well designed transformer today I would estimate that as approximately four per cent.

Q Is the answer you gave to my previous question about the amount of energy stored in the transformer based upon your assumption that the exciting current would be limited to about four per cent of the total? *A* I was basing it upon the same transformer, but considering it from the standpoint of full load rather than no load.

Q And for the purpose of giving that eight per cent [2763] figure, you considered the exciting current as amounting to about four per cent? *A* Yes.

Q Does the exciting current measure the stored energy as long as the supply voltage is the same? *A* I don't think it does.

* * * * * * *

Q Will you explain what you mean by that answer? *A* I have already explained that there are leakage fluxes within the transformer which appear under full load conditions that are not present under light load conditions. I have obtained four per cent additional, if you wish to have it in that form, as being based upon the energy stored in the leakage paths.

Q Is there a difference between the quantity of energy stored in the transformer at the point of maximum storage, and at some other time in the cycle? *A* Yes.

Q What is the difference? *A* The energy goes each cycle from its maximum value to zero, and back again.

[2764] *Q* The amount of energy stored? *A* That is correct.

Q Which you say at the maximum amounts to eight per cent? *A* That was my estimate of the ratio, yes.

Q In your direct examination I believe you said that many engineers believe that some of the, what you refer to as component currents, have separate existence. Am I right in that recollection of your testimony? *A* It sounds correct to me.

Q I don't believe you stated whether you believed that any of these component currents have separate existence. *A* I have tried to state in my testimony that that was a possible explanation, which was in agreement with all the facts, and that it was useful and that I used it in describing current the way I did. It is difficult to say that two things which occupied the same place in the mechanism of which I have described current are actually and entirely distinct or entirely mixed or combinations, but I have said that I could assume them to be distinct and reach all the correct results.

Q That assumption of independent existence is one, I believe, which you said is not susceptible to proof by physically observable facts? *A* That is correct.

Trial Examiner: Do I understand you to mean that it is not [2765] uniquely demonstrable, that other hypotheses may be equally sustained by the same observable facts?

The Witness: I think that expresses my position, yes, sir.

Trial Examiner: Thank you.

By Mr. Wahrenbrock: *Q* I wish you would explain a little more fully the method by which you would connect to a circuit carrying a three-phase current, the filters that you spoke of, for the purpose of your direct testimony. *A* Would I be permitted to use a textbook in which they are explained?

Q Surely. *A* I have one. I refer to a standard textbook entitled "Symmetrical Components", written by Messrs. Wagner and Evans of the Westinghouse Electric and Manufacturing Company, with whom I was associated, at the time of its preparation, published by the McGraw Hill Company in 1933. There is a whole chapter in the book devoted to measurement of sequence voltages, and sequence currents, which contains many such networks and their method of connection. It is chapter 14 and begins on page 271. If you wish, I will try to explain how one of those works, or I can refer you to the text wherein it is explained quite fully.

Q I wanted just a brief outline of the method of connect- [2766] ing the filters, and briefly how they work. I don't think we need a whole chapter of a book. *A* Well, is there any part of the chapter you wish? The filter consists of a series of reactors and resistors properly proportioned so that currents will flow in them in the desired manner. This series of reactors or resistors is internally connected and you might say is usually put up in a box, to which there are three terminals, one for a voltage measuring device and two terminals for the meter. The three terminals of the network which are intended for connection to the line, one is connected to each phase of the three-phase line. The remaining two terminals are connected to the meter. One of the simplest methods for measuring positive sequence voltage consists of a resistor and reactor in one leg, and a pure resistor in the other leg. In order to show their connections, I am afraid I would have to have a diagram that is the same as the one in the text.

* * * * * * [2767]

The Witness: Mr. Examiner, I have just completed the sketch of positive sequence filter or network, which is in accordance with figure 148 of Symmetrical Components, by Messrs. Wagner and Evans. By the use of the sequence filter or network, shown on the sketch, it is possible to connect the three terminals marked line terminals to the three-phase conductors of the three-phase [2768] system, and to connect the two terminals marked terminals for

network to a suitable meter, and calibrate the meter so that the indication on the scale corresponds to the positive phase sequence component of the voltages of the three phases.

* * * * * *

Mr. Wahrenbrock: To the reporter for identification, and I hand one copy to respondent's counsel, and keep one for myself, and ask that it be identified as Exhibit No. 84.

Trial Examiner: It may be marked Exhibit 84 for Identification.

(The document referred to was marked as Exhibit No. 84 for Identification.)

* * * * * * * [2769]

By Mr. Wahrenbrock: *Q* I wish to refer to that part of your examination in direct where you compared the operation of a motor generator set with the operation of the transformer at South Meadow, I believe, and ask you whether such a motor generator set would not require a source of direct current, in addition to the alternating current now supplied to the auto-transformer? *A* If you are inquiring into the method of operation of the motor generator set, such a motor generator set which would perform the operations I described would require direct current for its proper operation. However, that direct current could be provided by means of one or more direct connected exciters which are a part of the motor generator set.

Q I understand that a transformer does not require a direct current source of energy in addition to the alternating current supplied to the transformer? *A* That is correct. The necessity for the direct current is for the conversion to mechanical energy, which is the fundamental process of the motor generator set, which differs from that of the transformer.

Q Would the operation of the motor generator set involve a flywheel effect which would be different from the effect of the operation of a transformer? *A* I think that is correct, although I believe I stated [2770] that once steady state conditions had been established in the motor generator set, the differences would not

be detectable by external measurement. The flywheel effect would not be present except during transmission from one steady state condition to another.

Trial Examiner: I would like to ask one question while you are on that. There was some question in regard to operating losses in the use of a motor generator. Would those operating losses exceed those in the transformer?

The Witness: Certainly.

Trial Examiner: About what would the ratio be?

The Witness: At least four times as large.

Trial Examiner: That answers my question.

By Mr. Wahrenbrock: *Q* In considering the nature of the facilities at Bristol, I would like to ask you whether, if instead of obtaining the electric energy to supply Bristol from the present source, a generator or several generators had been provided at the load center in Bristol, those generators operating at a voltage of 13.8 kilovolts, under such circumstances would it have been necessary to install the three-winding transformers which were installed? *A* No, because the voltage of the generator has already been adapted to the load it desires to supply. However, it would have been necessary to incorporate under the conditions [*2771*] you stipulate a transformer to transform from 13.8 k. v. to 4.6 k. v. and that transformation is incorporated in the three-winding transformer that is there at the present time.

Q If, as a matter of fact, there had been generators supplied with a voltage of 13.8 k. v. and other generators with a voltage of 4.6 k. v., then no transformer whatever would have been required? *A* Assuming that the generators at 13.8 k. v. were always adequate for the load at 13.8 and correspondingly at 4.6.

Q And under the conditions that I have stated, that is, where a generating capacity is provided at the load center in Bristol, would it have been necessary to provide the synchronous condenser? *A* That may or may not have been so. I was told of an installation in the State of Connecticut where that has been done. I have in mind an article written by Mr. C. M. Lafoon, of the Westinghouse

Electric and Manufacturing Company, in which he proposes just exactly such a thing to increase the capacity of the generator. The question of whether or not it would be necessary, depends upon whether or not the generator had been designed to provide that capacity inherently.

Q With generators operating at normal capacity, would the use of a synchronous condenser be necessary? *A* I again state that that is a question of how the genera- [2772] tor may have been designed. In the case that I mentioned, it is my understanding that the generator had a capacity of so many k. v. a's. Because the turbine in question had a greater capacity than that for which it was sold, it was possible to increase the capacity of the turbine and generator to the maximum permissible k.v.a. of the generator, by supplying the reactive k.v.a. by means of a condenser connected at the same point.

Q Isn't that a very unusual kind of design? *A* I would say it was unusual, because it is possible to combine the functions of the condenser and the generator, if one wishes to do so, and it is economic to do it, so that normally, unless conditions change from those which are anticipated, or unless the maximum possible capacity is reached, due to some mechanical limitations, there would be no economic advantage in so doing.

Q In your direct testimony you referred to what I might designate as the increment of load theory, with respect to what you said was the practice of load dispatchers, under some circumstances. Do I understand that you say that is or is not used to trace the flow of energy from particular sources to particular loads? *A* It is used as one of the ways in which a load may be assigned to a particular generating station. I have testified, I believe, that that method is no more provable [2773] than any other.

Mr. Wahrenbrock: No further questions.

Trial Examiner: With regard to Exhibit 84 for Identification, I wonder if the witness would make for the record a statement of the meaning of the various symbols.

The Witness: I will attempt to do so.

* * * * * *

The Witness: The symbols inside the dotted line on the diagram represent the element of the filter or network which selects the positive sequence voltage component. The symbol marked "Z sub A" represents an impedance consisting of a resistance and a reactance. The symbol "Z sub B" represents a resistance alone whose magnitude is characterized by the letter "R". Returning to the impedance Z sub A, the resistance is one half the resistance R, and the reactance has a magnitude equal to .866R. With these values of resistance and reactance, the impedance Z sub A has the same magnitude as the impedance Z sub B, but has a phase angle of 60 degrees. Below the figure I have written down equations by which it may be deduced that the current through the meter is proportional [2774] to the positive sequence voltage. In the first equation the current in the meter is indicated by "I sub M". The voltage between phase conductors C and B is represented by the symbol "E sub cb". In the denominator of the first fraction we find R, epsilon to the power j60, which is the mathematical representation of the impedance Z sub A, which is connected across the phase voltage E sub cb, with the aid of a voltage transformer. The remaining fraction in this first equation consists of the voltage E sub ao, between the phase conductors and C divided by R, which is the value of the impedance Z sub B. In the next two equations the two voltages referred to are expressed in terms of the positive sequence voltage, E sub 1 and the negative sequence voltage E sub 2, each multiplied by the appropriate factor in which the expression "a" represents epsilon to the power j120, or it corresponds to a vector operator which performs the mathematical function of rotating a vector quantity 120 degrees. In the next equation these values are substituted in the first equation and in the following line the value is given, which is obtained on reducing the equation just mentioned. It can be shown that the last parentheses in the equation just above for I sub M reduces to zero, so that the factor [2775] multiplying the negative sequence volt-

age becomes zero and the current in the meter does not correspond to any proportion of the negative sequence voltage. The current in the meter is given as equal to three times E sub 1 divided by R. Upon proper calibration, the meter may be made to read directly in volts. I neglected to point out that two potential transformers which may be of any suitable ratio, so long as they are the same, are included in the filter, as represented by the conventional symbol for potential transformers or other transformers, as far as that use of the symbol is concerned. I also see that in tracing the carbon I did not trace through the circle around the letter "M" which represents the meter. If I may be permitted to do that, I can correct the copies.

Trial Examiner: We will permit the witness to correct those copies by inserting a circle.

* * * * * * [2776]

Redirect Examination by Mr. BRANCH.

Q There has been some questioning on cross-examination in regard to the synchronous condenser at Bristol. Is there any other facility or type of facility which might be used to accomplish the same purpose? *A* At the present time the result might be accomplished in several ways.

Q Will you explain them, and indicate the place where the facility would be located? *A* The ideal way for this power factor correction to be accomplished would be for the users of the power to provide synchronous motors instead of induction motors, so that the power factor of the load drawn by the customers can be made more nearly unity power factor than is encountered in most industrial loads. This would obviate the necessity for any external means for power factor correction.

Q And those motors would, of course, be located in the premises of the particular customer, would they not? *A* Yes. I have said that those would be the customers' loads, and therefore would have to be located in the customers' premises. If that were done, there would be little, if any, need of power factor correcting

equipment external to the [2777] customer. However, in many cases, customers cannot be required to use such motors by the rules of the power company, and induction motors having low power factor are used. In such cases, the power factor can be corrected equally well by means of static capacitors instead of synchronous condensers, and the static capacitors may be located at various points along the line. The closer they are located to the customer's premises the more satisfactory the power factor correcting operation.

In 1928, which as I understand is the date the Bristol synchronous condenser was installed, these static capacitors were not commercially economically available. The price of such capacitors has been reduced steadily in the last fifteen years to the point where they may now be used as economically in many cases, and even more so in a considerable number of cases, as a synchronous condenser to perform the function of power factor correction.

* * * * * * [2782]

CALVIN T. HUGHES,

a witness previously sworn, resumed his testimony:

Cross Examination (Continued) by Mr. WAHRENBROCK.

Q Mr. Hughes, I believe that you spoke of having designed the Bristol substation. *A* Yes

[2783] *Q* Is there anything about the design of the Bristol substation, that is, that you designed uniquely to handle the current from any particular source, or energy from any particular source? *A* Do you mean by that a particular type of energy, or as the design is determined by the area or the circumstances surrounding that particular place?

Q Well, I wish to know whether in your design of the substation, you designed the substation in a unique way to handle electric energy from any particular source? *A* Well, the source was established. I mean, so far as the transmission lines existed there at Bristol, at the time my work started; there was an existing

present line in Bristol, so my problem was to install at the receiving point there at the substation, and design—

Q Do I understand you designed the substation to operate with electric energy supplied to it from the C.P. 1 and C.P. 2 lines? *A* That is right.

Q Do I understand that you designed it to be supplied with electric energy over the C.P. 1 and C.P. 2 lines from any particular source? *A* I don't know that that came into the problem at the time. It was—When you say "any particular source", any source that arrived with energy of 66,000 volts or thereabouts, [*2784*] at the substation, would have been satisfactory.

Q So that, when on direct examination you stated that the substation had not been designed uniquely for the utilization or the distribution of electric energy from a source outside the State, you could just as well have said that it was not uniquely designed to handle electric energy from within the State, could you? *A* No, I couldn't, because I was generally familiar with the source of power that was available for Bristol.

Q Well, didn't I understand you just now to say that it didn't make any difference what the source was as long as it came over the C.P. 1 and C.P. 2 lines? *A* Not exactly that, no.

Q Now, what is the difference between energy delivered to the Bristol substation, which has its source outside the State, and that which has its source inside the State? *A* What is the difference between the energy?

Q Yes. *A* I don't know if there is any difference.

Q Well, would it have required any difference in the design of the Bristol substation to handle electric energy from outside the State from the design which you adopted? *A* That didn't enter into the problem. That didn't enter into the problem.

Q And it would have made no difference in your design? [*2785*] *A* Since I didn't have to consider that problem, it wasn't part of the problem.

Q Your problem was limited to taking whatever energy was delivered over the C.P. 1 and C.P. 2 lines? *A* That is correct.

Q And the source of the energy delivered over the C.P. 1 and C.P. 2 lines did not enter into your design problem? *A* Not particularly, no.

Q Well, you say "not particularly". Did it enter in at all? *A* Well, it entered in only so far that on a project of that magnitude and requiring that amount of power, you would at least see if there was a source available.

Q In the design of the station, did you assume that there was a source available to supply electric energy over the C.P. 1 and C.P. 2 lines? *A* Yes.

Q Then the location of that source didn't enter into your design problem at all? *A* We did know that there was a source. We did know that the power would be available.

Q You knew that there was a source, but did the location of that source affect your design? *A* Not particularly, no, not in detail.

Q Well, did it affect it at all? [*2786*] *A* Well, if there had been different sources further away, it could have affected the design.

Q And do I understand that in your design of the station you started with the assumption that electric energy would be delivered from some source over the C.P. 1 and C.P. 2 lines? *A* That is right.

Q Did you in your study and design of that substation consider any alternative source of supply? Did you consider for example the building of generator capacity in Bristol? *A* Well, of course that was quite a while ago. We didn't consider the building of generator capacity in Bristol. We did consider generally the possibilities of supplying that load from the main system of The Connecticut Light and Power Company.

Q Did I understand you to say that you did not consider installing generator capacity in Bristol? *A* We did not, but we did give some thought and consideration to the possibility of supplying it from the main system of The Connecticut Light and Power Company.

Q In designing that substation, what determined the primary voltage which you selected for the three-winding transformers? *A* By primary, you mean the 66,000 volt voltage?

Q What is now the 66,000 volt voltage. What determined that you would make it a 66,000 volt primary? [2787] *A* That was the voltage of the then existing line of the C.P. Company from which we obtained the power for Bristol.

Q And you made the primary voltage of the transformer 66,000 in order to adapt the transformers to the 66,000 volt lines? *A* Well, where you make a transformation between a source and a load you of necessity use the voltage that the power is delivered at.

Q The voltage of that primary was in no way determined by the distribution problem in Bristol? *A* Yes, because that was part of the distribution problem.

Q Well, how did your distribution circuits and their voltages affect the voltage of the primary? *A* Because you cannot have a transformer without a primary and a secondary, or the equivalent of it. If you receive energy at a point where you want to distribute it, and it is more economical to change that voltage or more feasible or practicable, well then, you change the voltage, just the same as you change the voltage in a customer's house, change the voltage from the circuit in the customer's house to a bell-ringing transformer.

Q If the C.P. 1 and C.P. 2 lines had been operated at 110,000 volts, what voltage would you have designed or ordered those transformers for? *A* Had we received power at 110,000 volts, it would have [2788] naturally followed that the winding that connected to that point of receipt would have been for 110,000.

Q If the distribution voltage in Bristol had been 6,600 volts, would that have affected the voltage of the high-tension side of the transformer? *A* No.

Q The fact that the distribution voltages were 13.8 and 4.6, and I believe in one case 2.3 k. v., didn't affect your determination of your selection of a 66 k. v. as the voltage of the primary, did it? *A* When you speak of voltage alone, no. The transformer

as a whole, it did affect—the transformer as a whole, that is, the amount of load and the voltages between the point of receipt and the points that we wanted to spread out, yes.

Q But the voltage of the primary was not affected by the distribution of voltages which you had to supply? *A* The voltage of the primary, as I have said, was to take the power as we received it.

Q If you had designed that substation so as to utilize steam generating capacity installed in or near the load center at Bristol, would it have been necessary for you to provide a transformer to step the voltage down from 66,000 volts?

* * * * * * * [2789]

The Witness: I might state it this way: One of the problems in the layout of the various apparatus at the Bristol substation had to take into account the fact that there was a steam generating plant there at the time, with some small turbines, boilers, and so forth. If I understood the question, you want to know if it would have been any different in the primary winding had there been a steam generating plant there. Do I get it right?

By Mr. Wahrenbrock: *Q* I will reframe the question, Mr. Hughes, to try to eliminate any uncertainty. Assuming that you had fully adequate generating capacity at your distribution voltages, would it have been necessary for you to provide the three-winding transformers? *A* If we had had a good source of power, a firm source of power at Bristol, no.

Q The three-winding transformer was then installed, in order to utilize the energy supplied over the C.P. 1 and C.P. 2 [2790] lines? *A* The three-winding transformer was used so as to more efficiently, more economically utilize or distribute the energy which was received from the C.P. Company.

Q And if you had had generating capacity, adequate generating capacity at your voltages available in Bristol, it would not have been necessary for you to have a transformer or group of transformers to serve the purpose which the present three-winding transformer served? *A* I take it that is a hypothetical case.

Q Yes. *A* Take the hypothetical case of a situation similar, a community the size of Bristol, and if you had adequate generating capacity to serve the territory, well then, you have it. The other problem doesn't come up. You don't have to consider that problem.

Q In that case, would you have to have designed that station to include a synchronous condenser? *A* Could have.

Q Well now, that wasn't my question whether you could have designed it to include a synchronous condenser. My question was would it have been necessary to do so, with adequate generating capacity at the distribution voltages? *A* That would have depended entirely upon the economics of the situation that maintained at that time. For example, [*2791*] we know, we did know at the time of the purchase of the condenser that the industrial loads in Bristol were of a very low power factor. In some cases, low power factor can economically be carried on the customer's premises or taken care of on the customer's premises, the leading current generated on the customer's premises, or produced. In other cases, for commercial practical reasons, that isn't done. Now, a generator at Bristol that was generating a load for the industrial power would have had to have been somewhat of a special design in order to get full capacity out of the generator, or else it would have been necessary to have provided a synchronous condenser, or its equivalent.

Q If your design problem at Bristol had included the providing of a—

* * * * * *

Q —of a source of power at Bristol, by the installation of proper steam generating capacity, would you have provided a synchronous condenser in addition to your properly designed steam generating capacity? [*2792*] *A* Since that was not a problem, it is purely hypothetical, and it could have well worked out to provide the synchronous condenser.

Q Can you name two instances in which that has been done in the design of a source of power? *A* It has been, as I understand

it, advocated by some people. I understand that there is one installation in Derby, where the synchronous condenser is in the powerhouse.

Mr. Branch: In the what?

The Witness: In the generating plant.

[2793] By Mr. Wahrenbrock: *Q* Are you able to name any other instances? *A* I haven't made any survey to determine how many there might be.

Q Do you know of any other instance? *A* I do not.

Q Do I understand you to say that when you design a new generator to supply a load that it is as economical to build a generator and a synchronous condenser as it is to build a properly designed generator? *A* I didn't say that. I said under certain conditions that might be true or could be true.

Q What conditions do you have in mind?

Mr. Branch: Well, I object. I think this is going way beyond the scope of proper cross examination. No such situation obtained, and to ask what might have been done under various conditions which didn't obtain, seems to me to get us nowhere. I think that this might be endless if we go into that.

Trial Examiner: Well, I thought the purpose of this examination was to test statements made by the witness as to the function of the Bristol substation. I believe on that point it is in order.

Mr. Branch: Will my objection and exception be noted?

Trial Examiner: The objection will be overruled and the witness may proceed.

[2794] Mr. Branch: That will apply to any further questions along the line of this hypothetical situation?

Trial Examiner: It is so understood.

By Mr. Wahrenbrock: *Q* You have referred to an instance where you say a synchronous condenser is located close to a generator. Where was that place? *A* It is in Derby, Connecticut.

Q Derby, Connecticut? *A* Yes.

Q Was that synchronous condenser installed at the same time the generator was installed? *A* No, I believe not.

Q Was it installed subsequently? *A* Subsequently.

Q Do you know of any other instance where a synchronous condenser is designed and installed in conjunction with the design and installation of a generator to operate together with the generator, at the same place? *A* That is the only instance I know, at Derby. Such installations have recently been proposed, I understand.

Q Do I understand that as a result of the further examination of the facilities of The Torrington Electric Light Company, which you made during the course of this hearing, you have intended to correct some statements you made when you [2795] testified earlier in this hearing with respect to the physical condition of the facilities there?

* * * * * *

Mr. Branch: I think that is too general and vague.

Trial Examiner: I would suggest that counsel narrow that somewhat.

By Mr. Wahrenbrock: *Q* In your earlier testimony in this hearing, Mr. Hughes, as I recall, you testified that some of the leads to some of the disconnects and possibly other facilities in the Torrington substation had been removed. Is my recollection correct? *A* The first time I testified—that was several days ago—I wasn't clear in my mind about the connections in the immediate vicinity of where the metering transformers were on the 2,300 volt circuit that supplies the small substation of the C. L. & P. Prior to that time I had been through the substation and just glanced very quickly at it, and my first impression was that a jumper had been opened up and I wasn't too sure about it when I testified, but I did find out that that jumper had not been opened up and I testified to that on direct examination this time.

Q And on the basis of the further study that you have [2796] made of the physical facilities themselves, you now wish to correct your earlier testimony and state that there has been no actual removal or change in any of these physical facilities?

Mr. Branch: Just a minute. I don't think that that is a fair statement. I think the witness testified that he was uncertain, in his original direct testimony, about some of those points. He has now explained what has happened, but I don't think that it is fair to indicate that there is a correction. I don't think there is anything that he said now that is at variance with what he said before, except now he is certain about a point which he said he was uncertain of.

Trial Examiner: I was under the impression that the witness had made the statement originally on direct, and then expressed uncertainty on cross-examination. I may be wrong. Is this something that is going to take a few minutes to look up? If so, we will take a five minute recess.

* * * * * *

Mr. Wahrenbrock: Mr. Examiner, in view of respondent's counsel questioning the assumption which I had made in my question, I propose to call the witness's attention to a few specific instances of his prior testimony, and I am perfectly willing, [2797] if he desires to do so, that the witness look at the transcript of his testimony.

By Mr. Wahrenbrock: *Q* I will first direct attention to page 2053 of the transaction, beginning with the 23rd line on the page, where Mr. Hughes said:

> "The connection now is through a lead that runs from the indoor bus to the outdoor structure where the lead has been opened up."

And I will ask you, Mr. Hughes, if that lead had been opened up? *A* Well, can I make a statement that I think will clear this whole business up?

Q I would just like to have that question answered, if I may.

Trial Examiner: The witness may answer.

A By lead, that is a question of terminology. As I just testified, I was originally under the impression that where the connections to the current transformer had been made, it was left

open. However, on further examination, I found that was not so, and I so testify.

By Mr. Wahrenbrock: *Q* And this statement that the lead has been opened up then, you now correct and say that that lead has not been opened up? [2798] *A* It had been opened up in order to make the connection, but it was reclosed. That is the truth of it.

Q And since June 17th it has been closed? *A* That is correct.

Q I now direct your attention to page 2056 of the transcript, beginning with line 19, where the following questions and answers are recorded:

"*Q* Could any such connection be made by closing disconnections or switches?"

I will go back farther in order to get the context, beginning on line 16:

"*Q* Is there any connection between those facilities and the facilities of the Connecticut Power Company?"

And your answer was, "No".

"*Q* Could any such connection be made by closing disconnects or switches?"

And your answer was, "I don't believe so. I think there is a section of cable that is removed."

"*Q* How long a section? *A* Oh, I really don't know, because if I remember right there is a set of leads to the south side, between the inside generating bus and the outside bus of the Torrington Electric Light Company that is disconnected at both ends.

"*Q* How long would it take to reconnect those leads? *A* Well, probably an hour or two."

[2799] And that ends my quotation. And I ask you now if any section of cable as referred to had been removed? *A* I believe originally there had. But apparently, some time during the oper-

ations between the 17th and the present date, a few days ago when I reinspected the plant, the leads had been put back into place.

Q Did you ever see that section of cable, any section of cable actually removed? *A* Just disconnected. Disconnected from the terminal lugs.

Q You have no knowledge of a section of cable actually being removed? *A* No.

Mr. Branch: As you are calling attention to this, Mr. Wahrenbrock, and as the witness has been on the stand several times, may I ask whether it is not true that the testimony that he is giving here was given at the time that you originally called him in this matter, as a part of your own case?

Mr. Wahrenbrock: I am just as anxious to get the matter straight, whether I called him or whether he was called by you. He is, in any event, an official of the respondent company.

Mr. Branch: Well, that is true, but I think it is fair to point out he was giving from his memory, and he indicated that right straight through.

[*2800*] Trial Examiner: Well, I think his answers amply have taken care of him on the question of lack of positive knowledge. He seemed to be quite careful in his earlier testimony and showed he wasn't sure.

By Mr. Wahrenbrock: *Q* In this testimony which I have last quoted, in which you referred to a set of leads to the south side, between the inside generating bus and the outside bus of The Torrington Electric Light Company, do I understand you to say now, on the basis of your further testimony, that that set of leads has not been disconnected at both ends? *A* That is correct.

Q It is correct that they have not been disconnected? *A* They have not.

Q Now, on page 2060 of the transcript, beginning with line 21, I quote as follows:

"*Q* Have the conductors which lead to the substation of

The Connecticut Light and Power Company from the substation of The Torrington Electric Light Company been disconnected from The Torrington Electric Light Company's 2300 volt bus, outdoor bus? *A* I presume you refer to the three heavy copper cables.

"*Q* Yes. *A* That run from the structure of The Torrington Company to the structure of The Connecticut Light and Power Company.

"*Q* Yes. [*2801*] *A* They have been disconnected from the Torrington circuits.

"*Q* When was that done? *A* I think that was June 17th."

And I ask you whether, on the basis of your further examination, you say that those three heavy copper cables had been disconnected from the Torrington circuits? *A* They had not. They had been disconnected, but they were placed back in connection. There were two points in my original testimony where I was not positive as to disconnections. One was on the inside circuit of the plant, and one was at the junction where the cables cross the Naugatuck River, come on to the structure on the east side of the river. I had merely taken a quick look at them, and my first impression was that they had been left open at the transformers, but when I examined them in detail a few days later to reassure myself, I found they were connected at that time.

Q Now, I think that would apply, and in order to make sure I am going to ask you whether that applies, to the answer which appears at the top of page 2068 of the transcript, beginning on the second line:

"The three heavy conductors that go to The Connecticut Light and Power Company are connected to an oil circuit breaker, to three heavy cables that come inside the plant and connect to a [*2802*] bus. In addition to that, there are cables that come into the plant from the outside substation that are disconnected."

I am perfectly willing to continue, although it is not necessary, and add:

> "And if I understand it right, I didn't go into the detail of the thing. I believe they have made some kind of a connection there, but as to whether any power came through the Connecticut—or from the Connecticut Power came through the Torrington bus to The Connecticut Light and Power Company, I don't believe it did. It was my understanding that it didn't."

And you want to say, on the basis of further examination, that there was no such disconnection as you referred to? *A* That merely indicates a disconnect open, doesn't it? Isn't that what it is talking about?

Q Your sentence to which I particularly direct your attention is:

> "In addition to that, there are cables that come into the plant from the outside substation that are disconnected."

A Yes. I had referred to that. That is one of the two places where I was confused.

Q Now, on that same page 2068, beginning at line 18, your answer is, with reference to certain switches:

> "They may have been closed, but it was at the time of a light load, and I didn't explore the matter. They just told me they had put back those jumpers for a short time."

[*2803*] Now, was that statement—

Trial Examiner: Do I understand, before we go any further, do I understand that respondent's counsel raises the question that this is not responsive to direct examination?

Mr. Branch: Yes, sir.

Trial Examiner: It seems to me that we should settle that point, because if it is a question on which it is desired to recall the witness on the part of Commission's counsel, it probably would be better done at some other point, and not interrupt the progress of respondent's case.

Mr. Wahrenbrock: I am willing that he should be called to clear it up. It is true that this line of questioning I am going through now, at least I am willing to assume, I think it is true, that this line of questions occurred in my direct examination of the witness.

[*2804*] Mr. Branch: May I interrupt you a minute? I think I can shorten this. We are anxious to have the true picture presented. My only statement is, in doing this, he is recalling him as his witness. I am perfectly willing he should do that now, with that understanding.

Trial Examiner: It is so understood on the record.

Mr. Wahrenbrock: I think it should not be, if the Examiner please, because on cross-examination it will be recalled, or on direct, by the respondent's counsel, Mr. Hughes did attempt to put in, to prove as an exhibit, a wiring diagram at Torrington, which raised all the same questions again. That being in the nature of cross examination, or further direct examination, I am entitled to go into that on this cross.

Trial Examiner: You mean that was present on direct examination of the witness?

Mr. Wahrenbrock: I am sorry.

Trial Examiner: You mean that was examination of the witness directly, in his present call?

Mr. Wahrenbrock: Yes.

Trial Examiner: Is respondent's counsel agreeable to that fact?

Mr. Branch: Well, I have gotten lost in the maze of this. Mr. Hughes has been on several times and so forth. We want the true facts to appear. The only thing that I don't want is to make it appear that the facts in regard to the testimony [*2805*] were any different than they were, and if it is made quite clear that this was when he was originally called by Mr. Wahrenbrock, having had his mind particularly called to that matter, it is all right.

Trial Examiner: The statements appear to have been made at that stage, although the question of the connection appears also

to have been placed in issue in your direct examination. You may proceed.

By Mr. Wahrenbrock: *Q* I believe this last question to which I referred occurred when I was seeking to ascertain whether there had been any resumption, temporary or otherwise, of supply of power from The Connecticut Power Company to Winsted, and in that connection, you said, as I have quoted you on page 2068:

> "They just told me that had put back those jumpers for a short time."

Now, I would understand from that that some jumpers had been removed. Will you state whether those jumpers had been removed? *A* I can't state that of certain knowledge. What I thought that you were speaking about is that for a while the connection was reestablished, and at the time of that conversation or testimony I was still under the impression that the leads on the inside of the plant had been loosened up and taken off, and from my knowledge of the connection at that time that was the [2806] way they reestablished the connection.

Q By closing those leads or jumpers, as you refer to them? *A* Yes.

Q Now, actually those jumpers were closed, and as your study shows they have been closed since June 17th? *A* When you say June 17th, I can't testify to that. I know they were closed the day I looked at them, last week. They had been removed and put back. Just when they were put back, I don't know. I don't think it is material anyway.

Q And the only times that you have any knowledge of, the jumpers were closed? *A* That is right.

Q I want to direct attention to page 2074 of the transcript beginning with line 6, where you were discussing one of the diagrams and you referred to certain lines in the following language:

> "They are dotted and are shown as owned by others, and if I remember right, when I visited the plant the lugs were removed from the cables on that set of disconnections, to

which the right-hand—where there are two sets of cables, just to the right of where the number 980 appears on it. I believe that was done as a safety measure. I don't know exactly. I didn't look into it in particular, but it does show the diagram, with that exception."

[*2807*] I ask you whether, in view of your further study, you wish to correct the statement that the lugs were removed from the cables? *A* Not from the cables, the terminals. That is the second of the two points that I did endeavor to clear up. There were two points. That is the second of the two points.

Q Do I understand you now that if those lugs were ever removed, they had been reconnected, and your only knowledge of them is that they are there, they are reconnected, and are connected now? *A* That is correct.

Q I am going to direct your attention to transcript page 2079, beginning on line 16, where the question is:

"Are the leads to the disconnects or to the oil circuit-breaker in place and properly connected, or are the leads disconnected? *A* I don't recall. I believe some of them are connected. I recall some of them but not all of them. I could not certify as to all of them."

And I ask you now whether, on the basis of your further examination, you state that all the leads are in place? *A* They are in place.

Q And on the following page, 2080, the first line:

"*Q* So the leads to some one or more of those may be disconnected? [*2808*] *A* That is right."

And with respect to that, your answer is the same? *A* Yes.

Trial Examiner: What do you mean by "the same"? Counsel has not made it clear.

By Mr. Wahrenbrock: *Q* That is, your answer is that the leads are not disconnected? *A* That is right, not disconnected, mean-

ing by "not disconnected" that you are not including disconnects by that.

Q I understand what you mean, but I am not sure that it is straight on the record, Mr. Hughes. Will you make that a little clearer, please? *A* The point being this: As I have said before, all this whole question here is about two points; that I was not clear in my mind as to whether a section of the conductor had been removed. When I examined them in detail, I found that they had not been removed. Apparently some lugs had been taken out of disconnects and replaced, but I want to make this clear, and on my recent examination, certain disconnects were open, but not removed from the circuit. The circuit breakers were open, but were not removed from the circuit.

Q When you say "certain disconnects" were open, by "disconnects" you mean what a layman would refer to as a kind of a switch? [*2809*] *A* A knife-switch operated by a switch stick, as against operated by electrical or mechanical means.

Q And the opening of such a disconnect is a different matter from the removing of bolts or the removing of copper connections and actual physical disruption of the circuit? *A* It is a different mechanical operation, but electrically it accomplishes the same result.

Trial Examiner: But, as I understand, it is simply a switching proposition. The circuit can be instantaneously closed so far as any one point is concerned?

The Witness: No sir; that is not correct.

Mr. Wahrenbrock: The examiner is referring, if I understand him, to the opening of the so-called disconnects.

The Witness: That is the way I understood him.

Trial Examiner: That is what I mean.

The Witness: A disconnect is ordinarily equivalent to a bar of copper or a blade of copper, referring to dimensions generally, probably a foot long, maybe a quarter inch thick, two and a half inches wide. It is hinged at one end and mounted on an insulator and there is a contact provided at the other end,

and in order to open it, since it is alive and ordinarly bare, you use an insulated hook that has a wooden handle, and you insert a bolt or something like that in an eye that is provided for opening the disconnect and manually operate the switch or disconnect switch. [*2810*] There are two kinds of switches involved here. One of them is what is known ordinarily as an oil circuit-breaker or an oil switch and usually they can be operated from the switchboard by a control switch and operated remote from the position, although not always.

Trial Examiner: Well then, the only difference from what I had in mind is that it would take more than an instant to close them. It is more like a comparison of closing a switch and large gate, that you may have to take a few steps to close, but nevertheless it is simply a matter of closing a circuit, and everything is there with which to close it?

The Witness: No, sir; it is a little more than that. In electrical terms it is a little more than that. You can safely close many things through an oil circuit-breaker, many types of circuits. There are relatively few that can be closed by a hand-switch, that is, where there is much power. For example, in Torrington, by closing certain switches you would parallel two systems and that parallelling requires speed, and when you put them together it has to be done very quickly, and if anything happens to be wrong, well then there is some protection, the breaker will automatically take care of the situation, whereas if you try to close the circuit with a disconnecting switch you are more likely, if everything isn't in order, to have it blow up in your face. For that reason it isn't considered safe practice to close circuits [*2811*] above certain capacities with disconnects.

Trial Examiner: I see.

By Mr. Wahrenbrock: *Q* Well, Mr. Hughes, I would like to just add to what you have said by asking you this: Isn't it true at Torrington that there are oil circuit-breakers provided in every instance, so that with the oil circuit breakers open in the proper manner, any set of disconnects that you wish to close can

be quickly closed manually and then whatever phasing or actual closing of the circuits is desired can be carried out by the operating of the oil circuit breakers? *A* It is true that any place that they could be tied together there is an oil circuit-breaker, but there are also disconnecting switches that are open.

Q I wish to refer further to page 2083 of the transcript, beginning with line 20:

> "My impression is that a lead was taken off of that disconnect, so that the connection that runs to the breaker 980 might be connected to it."

I wish to ask you whether that lead, if it was taken off, was replaced? *A* Could I have the diagram as a reference? I don't remember the 980.

Trial Examiner: May the witness see the diagram?

[*2812*] Mr. Wahrenbrock: I will be glad to show my copy of Exhibit No. 80 for Identification, inasmuch as respondent's counsel has asked me to do so? It has some marks on it which I will ask you to disregard.

By Mr. Wahrenbrock: *Q* My question now is whether the lead that you were referring to as one that was taken off of that disconnect, if that was so taken off, has been reconnected, replaced? *A* That is correct.

Q And I refer next to page 2086 of the transcript, beginning at line 10 where your answer reads:

> "It isn't exactly the same way, because there have been some disconnections removed there, if my memory serves me right."

And ask you whether those connections are removed? *A* I don't know where you are referring to now.

* * * * * *

Q I show you the page in the transcript to which I have referred, and direct your attention to the answer which I have read, beginning on line 10. [*2813*] *A* That is the same point, near

the current transformers on the circuit. I was under the impression that there was a lead from the current transformer disconnected. On further examination I found that it was not.

Q Now, at the time my cross-examination was suspended to permit respondent's counsel to put on their expert witness, Lewis, you were referring to your own notes, or to a diary or a journal or something, a little book of your own, to obtain some data with respect to the interruptions in service which have occurred since June 17th. Do you have that? *A* I believe there were two interruptions.

Q When were they? *A* June 29th, a very short one, and June 20th, if I remember right.

Trial Examiner: Both in June?

The Witness: Yes, sir.

* * * * * * [*2814*]

Q Directing your attention to June 19th, was there about 1:30 A. M. on that day a period of time in which Winsted was without electric energy for several minutes? *A* If I remember, there was around a ten-minute interruption, around June 20th, the 19th or 20th. I am pretty sure it was the 20th.

Q What time of the day? *A* I don't know.

Q On that day was the 3125 k. v. a. turbine cut out and another turbine cut in for an hour and a half or so? *A* Are you speaking of June 20th?

Q June 20th. *A* I don't know.

Q Are you able by referring to your notes, or your journal diary, to ascertain that? *A* No.

[*2815*] *Q* Have you any records available to you from which you could— *A* I may be able to. There were two, one of which I had some information on and the other one I didn't.

Trial Examiner: How long will that require?

The Witness: I don't know I have no information on that. I have information on June 29th.

By Mr. Wahrenbrock: *Q* All right. I would like to ask you

now what happened on June 29th? *A* On June 29th, there was some difficulty with the 3150 k. v. a. turbine. I believe that the 1250 k. v. a. turbine was started up, and the lines were parallel with the C. P. system and the two systems ran together until about 11 o'clock, 11 P. M. on the 29th and were separated at that time. There was some emergency due to a bearing heating or something of that nature.

Q When were the two systems paralleled first on that day? *A* I think shortly after noon.

Q Would it have been about 12:24? *A* Thereabouts.

Q Why weren't the two smallest generating units of the Torrington Electric Light Company used that day?

* * * * * * [*2816*]

A I wouldn't know. I don't know.

By Mr. Wahrenbrock: *Q* You have no knowledge as to why they weren't used? *A* No.

* * * * * * [*2818*]

Q Did you make any effort to find out why the Torrington Electric Light Company was unable to carry the Winsted load on the 29th? *A* I made an inquiry and was told that there was bearing difficulty, I believe.

Q On the 3125 k. v. generator? *A* That is correct.

Q Did you seek to find out why they couldn't carry your whole load by utilizing as much of their remaining steam generating capacity as might be necessary? *A* That was a question that was settled right on the spot, and why they didn't do it would only be in a man's mind that was right there at the time. I wouldn't know.

Q You made no effort to find out why they hadn't done that? *A* I inquired, but generally speaking, it was past, and I didn't make any specific inquiry as to why they didn't try to use the smaller units.

Q Were you given any facts which enabled you to decide why

they hadn't? *A* I drew my own conclusion as to why they didn't.

Q What was that conclusion? [*2819*] *A* On the 29th—you are talking about as of the 29th?

Q Yes. *A* I believe that the operator got a little excited, and his thought was to avoid a long interruption to the service. As I get the story, from what little meager information I have been able to pick up, he got a little unduly exercised about the situation, so he tied in with the C. P. system, as a precautionary measure, because it seems like that the difficulty, or what caused them to do it, developed very quickly.

Q Would the utilization of the two smallest steam generating units at Torrington have required a long interruption of service? *A* I don't know that. Under ordinary circumstances, I should say no.

Q How long an interruption would have been necessary on the 29th in order to utilize those two units, in your opinion? *A* I would say—

* * * * * *

The Witness: Under normal conditions, it shouldn't have [*2820*] required any interruption.

* * * * * *

Q Were there any abnormal conditions? *A* I understood a bearing on the turbine got hot.

Q What has that got to do with the amount of time that would be required to cut in the two small units? *A* Quite a lot.

Q Will you explain. *A* Well, if a bearing is noticed to be hot, it is necessary to take the unit off the line very quickly, or considerable damage might be done to the unit. Normally that doesn't happen. Sometimes it happens in emergencies, which happened here. Normally there would have been plenty of time to start up a smaller unit.

Q Then, do I understand that the smaller units are not quickly available in case of an emergency? *A* By quickly available, they are not running, if that is what you mean.

Q How long would it take in case of emergency to get [*2821*] the smaller units on the line carrying loads, carrying their normal rated loads? *A* I have no certain knowledge of that, but I would estimate better than an hour.

Q How much more than an hour? *A* At least an hour. Probably longer, I don't know.

Q Now, you indicated, I believe that the Torrington steam plant on June 29th was operated in parallel with the Connecticut Power Company system from about 12:24 until about 11:00 o'clock in the evening. Is that right? *A* That is correct.

Q Was any effort made during that period of time to get the two smaller steam units on the line carrying the load, instead of utilizing the Connecticut Power Company energy? *A* I don't know.

Q Did I understand you to say you don't know? *A* I don't know.

Q Did you make any effort to find out? *A* No.

Q Were you given any facts which indicated to you why that wasn't done? *A* No.

Q Since June 17th, have there been an unusual number of brief interruptions due to lightning, or other causes on the line?

* * * * * * [*2822*]

The Witness: I wouldn't say an unusual number, no.

By Mr. Wahrenbrock: *Q* Do you know what interruptions there have been? *A* There has been one, I know, due to lightning.

Q Only one? *A* Yes.

Q You have no knowledge of any other interruptions due to lightning or other causes? *A* No.

Q Except the interruptions you have already testified to? *A* One. Two altogether.

Q Do you know whether on July 1st the Winsted switch opened three times? *A* No.

Q Do you know whether on July 8th, between 4:39 and 4:43 A. M., the Winsted switch opened four times? *A* What day?

[*2823*] *Q* July 8th. *A* I didn't know it.

Q On June 29th, when the Torrington plant and the Connecticut Power plant were operated in parallel, what switching operations were necessary in order to accomplish that?

Mr. Branch: I object on the ground that it doesn't appear this witness was there, or that he has personal knowledge.

By Mr. Wahrenbrock: *Q* I will ask if he knows what switching operations were necessary in order that the two be operated in parallel? *A* I don't know the details of all the operation, but I know generally what was done.

Q Well, will you state what was done? *A* I believe the disconnects to the oil circuit breakers were closed, and the oil circuit breakers closed, the oil circuit breaker, that is, that had formerly been connected to the circuit supplying Winsted.

Trial Examiner: Is that a statement of opinion, or is that procedure that your employees are directed to follow?

The Witness: That happens to be—I inquired about that particular day from the man directly in charge of it.

Trial Examiner: You used the expression, "I believe", and that is the reason I asked.

Mr. Branch: May I call your Honor's attention to the [*2824*] fact that he referred to "your employees". My understanding of this matter is, as far as all the testimony goes, that this is not what is done by his employees, but some employees of the Torrington Company.

Trial Examiner: I stand corrected on that point. I didn't mean to assume anything in the question. I meant the employees at the station.

By Mr. Wahrenbrock: *Q* Do you know how long an interruption was occasioned or was necessary at the time the connections

were made to operate the systems in parallel? *A* I don't know of certainty, but I understand that it was a very short time.

Q Do you know whether it was a one-half minute interruption? *A* I understood it was a little longer than that. In the order of four or five minutes, as I understood it. I was given that impression anyway.

Q Would that represent the length of time necessary to operate or to close the necessary disconnections and operate the oil circuit breakers? *A* Not necessarily, no.

Q That is, the disconnects and the oil circuit breakers might be operated in less time than that? *A* They might require a great deal more time.

[*2825*] *Q* Might they be operated in less time than that? *A* It depends on what the setup is at the time. At the time the cut-over was made that you speak of, there were several men present, and that could be arranged to be done rapidly.

Q Do you know whether it was done rapidly? *A* Yes.

Q Do you know how long it took it to be done? *A* Somewhere in the order of four or five minutes, as I understood it.

* * * * * *

Redirect Examination by Mr. SMITH.

Q Mr. Hughes, is the synchronous condenser in Bristol in continual use? *A* No.

Q Can you explain when and why it is used? *A* The Bristol condenser is used during the periods that the industrial load is on, or, I mean by that, when the larger industrial customers are drawing considerable power. It is not on nights, Sundays, holidays, a good many Saturday afternoons, and is ordinarily during the work week started up, in the morning, about the time the factories [*2826*] start, or the loads start to come on, and it is shut down in the evening.

Q What relation does what is done have to the 13.8 k. v. line running out of the Bristol substation? *A* It is always started, and our sole objective in operating the condenser, I say our sole objective, it is the major, if not its entire use, is to maintain the

voltage on the 13,800 volt bus with which the 13.8 feeders are connected.

Q Has that been so at all times? *A* For a great many years.

Q Since 1936? *A* Yes, since 1936.

Q Since 1935? *A* Prior to 1935, I am not too clear about it, because we were—at that time we were operating—

The Reporter: I didn't hear the last part of the answer.

The Witness: Prior to The Connecticut Light and Power Company were in the Exchange.

* * * * * * [*2827*]

Trial Examiner: Will you read the last answer slowly and loudly? It seems to me there is an extra "prior".

(Whereupon the last answer as above recorded, was read by the reporter.)

Trial Examiner: Is something omitted there, Mr. Hughes?

The Witness: I would say there is one "prior" too much. Prior to 1935 we were operating in the Exchange. That gives it the sense I want.

Trial Examiner: Prior to 1935 you were operating in the Exchange?

The Witness: That is correct.

* * * * * *

Q I believe you testified that for some time you were away from the company and returned on a certain time. Would [*2828*] you explain when you were away, and why, and when you returned in this year? *A* I was away six weeks prior to June 30th. I returned to work on Monday, June 30th.

Q Mr. Hughes, you testified in answer to a series of Mr. Wahrenbrock's questions, that certain jumpers were closed since June 17, 1941; that certain jumpers were closed, certain lugs were connected, and certain leads were in place, contrary to some impression you might have had hitherto. Do the facts that those facilities were closed or were connected—do you mean by that that there was any connection between The Connecticut Light

and Power Company line and The Connecticut Power Company's line? *A* I don't meant that, no.

Q Will you explain why you don't mean that? *A* Because at the same time there were disconnects and oil circuit breakers open.

Q When you say at the same time, what do you mean? *A* Over the same period, except for one instance that we cited.

* * * * * * [2831]

Q Would you describe the line from Robertsville to Winsted, and what it does?

* * * * * *

A It is a 4,800 volt distribution circuit which supplies a great many residential customers en route and extends a considerable distance beyond Robertsville.

[2832] By Mr. Smith: *Q* In one direction, and how does it extend in the other direction? *A* It extends north beyond Robertsville and from Robertsville back to the Winsted plant, with branches off of it at several places.

Q And these branches do what? *A* They serve domestic customers mostly.

Q Mr. Hughes, you testified that since 1936 the synchronous condenser at Bristol was used entirely as a matter of voltage control on the 13.8 k. v. line. I want to ask you whether or not that is the fact of its use since August 26th, 1935, the passage of the Federal Power Act? *A* Yes.

* * * * * * [2834]

SAMUEL FERGUSON,

a witness called on behalf of the Respondent, previously sworn, resumed his testimony:

Direct Examination by Mr. BRANCH.

Q Mr. Ferguson, you have previously testified in this case as a witness called by the Federal Power Commission? *A* I have.

Q And I think you testified that you are the president of the Hartford Electric Light Company? *A* I am.

Q And how long have you been president of that company, approximately? *A* I think it is about fifteen years ago that I was elected president. But I have not been president continuously through that time. For an interval of about three years I was Chairman of the Board and not president. I subsequently retained the position of Chairman of the Board, and resumed the duties [*2835*] as president as well, and I have had the two positions for the last three years.

Q During all of that time you have been familiar with the business and affairs of that company? *A* I have.

Q During those fifteen years? *A* Yes, sir.

Q I think you also testified that you are an officer of The Connecticut Power Company? *A* I have held the same offices in The Connecticut Power Company. I am at present president and Chairman of the Board of The Connecticut Power Company.

Q And for about how long have you held those positions? *A* The same period.

Q And you have been familiar with the affairs and business of those two companies all that time? *A* I have.

Q Mr. Ferguson, there is in evidence a contract between The Hartford Electric Light Company and The Connecticut Power Company, Exhibit 36, to which I call your attention; paragraph 4 refers to the undertaking of the Hartford Company to supply the capacity at certain places, which include Middletown and Torrington, and there is also a provision for furnishing additional capacity which may be required from time to time. You see those provisions? [*2836*] *A* I do.

Q And you are familiar with the fact that there has been an agreement with those provisions? *A* That has been about the contract and the agreement.

Q And I also call your attention to another document which is a copy of a contract between The Hartford Electric Light

Company and The Connecticut Power Company. I am informed that that copy that is in evidence is marked Exhibit 37, and that is dated, the first contract, Exhibit 36, was dated June 1, 1936, and this one is dated June 8, 1937. I call your attention to the reference to a contract by which The Connecticut Power Company undertakes to supply The Connecticut Light and Power Company with its requirements of electric power for its Bristol district, and the provision in Article 2 that the seller agrees to take all the buyer's requirements—the seller being—well, that isn't the contract, I think, that I mean. I call your attention to Exhibit 8, a copy of Exhibit 8, which is between—no. I think I was right at first and wrong the second time. Exhibit 37, dated June 8, 1937. In that the Hartford is called the seller, Connecticut Power Company the buyer, and the seller, that is, the Hartford, agrees to supply, and the buyer agrees to take all the buyer's requirements under Article 3 of said agreement of December 16, 1936, between [2837] the buyer and The Connecticut Light and Power Company, relative to the Bristol district. You see that provision? *A* Yes, I do.

Q And you are familiar with the fact that there was such a contract? *A* I am.

* * * * * * [2838]

By Mr. Branch: *Q* I call your attention to Exhibit 36, to the copy of an agreement made as of June 1, 1936. I have already mentioned the provisions. It has to do with supplying the demand at various load centers, including Middletown and Torrington, and I will ask you what the arrangements were between the Hartford Electric Light Company and The Connecticut Power Company, if there were any such arrangements, before the time as of which this contract, Exhibit 36, took effect? *A* For many years prior to 1936 the Hartford Company has continuously recognized this obligation to supply all the power for The Connecticut Light and Power Company at Bristol, and even prior to its being a territory of The Connecticut Light and Power Company. Immediately preceding—strike that out, please.

Q May I interrupt you just a minute, Mr. Ferguson? I am afraid I have confused you a little, because this contract doesn't refer to Bristol, but to Middletown and Torrington. *A* I didn't refer to the contract except as to the date, to fix the time that you referred to, and prior to the date, prior to June 1, 1936, in addition to supplying power at the load centers mentioned, Hartford for many years had recognized [2839] its responsibility for furnishing all the power utilized in the Bristol territory.

Q And was that also true of the loads at Middletown and Torrington? *A* It was, and the other places also.

Q And during the time, so far as you know, were there any formal contracts, specifically covering the matters which are covered in Exhibits 36 and 37? *A* Exhibit 37, executed approximately a year after the contract, Exhibit 36, reduced to writing in the form of a signed contract the practice which had been carried on by The Connecticut Power Company and Hartford, since June 1, the date of the contract in Exhibit 36. Although it had not been reduced to writing, the bills in the period were in accordance with the contract as shown in 37, which were rendered on a verbal understanding, subsequently reduced to writing and appearing in the contract, Exhibit 37.

* * * * * *

Q. Mr. Ferguson, may I start you back a little further. [2840] Exhibit 36 is a contract between Hartford and The Connecticut Power Company, relating to supply of the loads at places, including Middletown and Torrington. Now, before that contract of June 1, 1936 was made, was there any formal contract relating to that same matter between those two same companies, your two companies? *A* No, there was no formal contract. The responsiblity, as I testified, was recognized by Hartford for many years prior to that time.

Q In respect to the loads at Middletown and Torrington? *A* And Bristol.

Q And prior to 1936 did The Hartford Electric Light Com-

pany receive payment for taking care of the demand, as well as an energy charge for the loads in those three places, Torrington, Middletown and Bristol? *A* It did.

Q And had that been the practice as far back as your connection with the Company goes? *A* Yes, sir; there has always been a demand and energy charge, but it has been varied by verbal agreements from time to time over the period of the last fifteen years. I don't mean to say that the charge has been identical in amount, but it has always been billed on the basis of a demand charge and an energy charge.

Q And is it true that The Connecticut Power Company has [*2841*] paid to the Hartford Electric Company for whatever it received in that prior period from the companies which had the plants at Middletown, Torrington and also Bristol? *A* Prior to 1936 Bristol and Torrington were looked on as customers of The Hartford Electric Light Company. The Connecticut Power Company was looked on as the transmitting and billing agent. The Connecticut Power Company billed The Connecticut Light and Power Company for electric service at Bristol, in accordance as they received instructions at Hartford. They received the bill and Hartford billed them for the identical amount. They were paid for their trouble by a transmission service charge.

Q And did the load at Middletown include the load for the East Hampton district of The Connecticut Light and Power Company which was served through Middletown? *A* It included any territory served by Middletown.

* * * * * * [*2842*]

Cross Examination by Mr. WAHRENBROCK.

Q Mr. Ferguson, I show you Exhibit 51 which is an agreement recited to have been made as of the first day of November, 1930, by and between The Connecticut Power Company, referred to in the contract as the Power Company, and The Connecticut Light and Power Company, referred to in the contract as the Electric Company.

* * * * * *

Q Mr. Ferguson, is the contract of which 51 is a copy the contract under which The Connecticut Power Company supplied The Connecticut Light and Power Company with its requirements at Bristol, prior to the contract of which Exhibit 8 is a [*2843*] copy? I show you—*A* There is nothing in the exhibit to show how long this was effective, or whether it covered the full interim between 1930 and 1936. But it was a contract under which power was furnished, at some part at least, of that period and was backed—the delivery was backed by the Hartford Electric Light Company.

By Mr. Wahrenbrock: *Q* I show you Exhibit 8, and ask you whether by referring to the first "Whereas" clause in that contract, you are able now to state whether Exhibit 51 is the contract under which The Connecticut Power Company was supplying the requirements of The Connecticut Light and Power Company up until the execution of the contract which is Exhibit 8? *A* Exhibit 8 is a copy of a contract which recites that it is superseding the contract, a copy which has been given me as bearing the Exhibit No. 51.

Q Do you know whether, as a matter of fact, Exhibit 51 is the contract under which The Connecticut Power Company supplied The Connecticut Light and Power Company at Bristol up to January 1, 1937? *A* It so recites, but I would have to study the contract.

Q Can you do so and make a definite statement? *A* I can make that statement, but I cannot state whether or not subsequent changes were made in the terms by mutual [*2844*] consent. It is the contract that was superseded by Exhibit 8.

Q Except as Exhibit 51 may have been modified, it is the contract under which The Connecticut Power Company delivered energy to The Connecticut Light and Power Company at Bristol up to January 1, 1937, is it? *A* The superseding contract gives the date of December 16, 1936.

Q And I call your attention to Article 2 of Exhibit 8 which you have referred to as the superseding contract, which reads, "Commencing January 1, 1937, the seller agrees to supply and the buyer agrees to take and pay for electric power under the terms and conditions as hereafter set forth". *A* I presume the billing was effective as of January 1st. [*2845*] Then up until the time Exhibit 8 became effective, was Exhibit 51, the contract under which The Connecticut Power Company sold and delivered electric energy to The Connecticut Light and Power Company at Bristol, except as 51 may have been modified by letter or supplemental agreements? *A* It so recites, and I believe that is the fact.

Q You believe it is the fact? *A* Yes.

Q I would like to ask you whether you know of any modification or supplemental agreement that was entered into between the companies modifying or changing any of the terms of the contract which is Exhibit 51? *A* I have brought with me bills, copies of bills, for the month of May, 1934, as illustrated, between The Connecticut Power Company and The Connecticut Light and Power Company, and between The Hartford Electric Light Company and The Connecticut Power Company. Whether these bills are in accordance with this contract, or how they vary, could not be determined without carefully checking up and the bill department rendering and figuring those bills in exact accordance with the contract. The fact is shown by the bills that I have in my hand, what actually occurred. The Connecticut Power Company billed The Connecticut Light and Power Company for power delivered at Bristol with a demand charge, an energy charge and a rental [*2846*] charge. The total amount of $24,058.33. This sum, in turn, was billed by The Hartford Electric Light Company to The Connecticut Power Company, this same amount of $24,058.33, in an item on a bill rendered, which states:

> "Bristol, as figured by you, 2,372,500 kilowatt-hours, $24,058.33."

* * * * * * [2847]

ARTHUR J. HOPPER, JR.,

called as a witness on behalf of the respondent, being duly sworn, testified as follows:

Direct Examination by Mr. BRANCH.

Q Will you please state your name? *A* Arthur J. Hopper, Jr.

Q Will you speak a little louder, Mr. Hopper? What is your home and your business address? *A* My home address is Spring Street, Southington, Connecticut. My business address is 250 Freight Street, Waterbury, Connecticut.

Q By whom are you employed? *A* The Connecticut Light and Power Company.

Q How long have you been employed by that company? *A* Approximately fourteen years.

Q What is your position with the company? *A* I am an assistant engineer.

Q Have you been in that position during all those fourteen years? [2848] *A* Yes.

Q What was your technical education and experience, before you entered the employ of that company? *A* I was graduated from Cornell University with the degree of Electrical Engineer in 1925. I came with the company in 1927. In the two intervening years I was with the Utah Power and Light Company, doing operation and construction work in Idaho and Utah.

Q What are your duties with the Company at the present time? *A* I am a member of the Research Department, with assigned duties comprising load studies of various parts of the system.

Q Have you made certain studies in connection with 321 days which were listed by Mr. Miller on a list entitled "Days having hours when Falls Village Generation was zero and simultaneously Massachusetts energy was received at South Meadow Substation", and another list entitled "Days having hours when Falls

Village Generation was less than the deliveries to Central Hudson Gas and Electric Corporation, and simultaneously, Massachusetts energy was received at South Meadow Substation". I refer to the lists which are in evidence as Exhibits 64 and 65? *A* Yes, I have.

[*2849*] *Q* In your study, did you examine the log sheets of the Connecticut Valley Power Exchange for each of the 321 days which appear on these lists? *A* Yes, I did.

Q Did you use the methods described by Mr. Miller in his testimony in order to ascertain the number of hours in these days in which the conditions mentioned in the title to the list were fulfilled, according to his theories? *A* Yes, I did.

Q Have you a table showing the result of this study? *A* Yes.

Q Is this it? *A* Yes.

Mr. Branch: I am handed a table of one sheet, the first line of which reads, "Memorandum Showing Number of Hours in Exhibits 64 and 65", and I am giving Commission's counsel a copy, and I am giving the Examiner a copy, and I ask that it be marked for identification as the next exhibit number which is 85.

Trial Examiner: It will be marked Exhibit 85 for Identification.

(The Document referred to was marked as Exhibit No. 85 for Identification.)

By Mr. Branch: *Q* What was the period covered by the 321 days which you covered in your search? [*2850*] *A* It covered the years 1937 to 1940 inclusive, and the first five months of 1941.

Q How many hours were there in the entire period of four years and five months? *A* 38,688 hours.

Q During how many of these hours were either of the conditions mentioned in Mr. Miller's lists, which are Exhibits 64 and 65 fulfilled, according to the methods which he said he used?

* * * * * * [*2851*]

Q Will you answer that question? [*2852*] *A* 1,676 hours.

Q And what percentage is that of the total number of hours in the period covered? *A* About 4.3 per cent.

* * * * * *

Q Have you conducted an examination to determine the relationship between the amount of electric energy generated hourly by plants in Connecticut of The Hartford Electric Light Company and The Connecticut Power Company, on the one hand, and the combined loads of The Connecticut Light and Power Company which were connected with the Connecticut Power lines from January 1, 1937, to June 30, 1941; the loads to which I refer are the amounts purchased at the Winsted, Bristol, and at the East Hampton districts, during the period when that district was connected with the Connecticut Power lines.

* * * * * * [*2854*]

The Witness: Yes, I have.

By Mr. Branch: *Q* Will you summarize briefly the result of that investigation?

Mr. Wahrenbrock: The same objection to that.

Trial Examiner: The witness may answer the question. The objection will be noted.

The Witness: There was no hour during this period during which the plants in Connecticut which you have mentioned generated less than such combined loads of The Connecticut Light and Power Company in Bristol, Winsted, and East Hampton.

By Mr. Branch: *Q* Will you describe the data which you examined, and the method which you adopted in coming to the conclusion which you reached? *A* First, I examined the log sheets of the Connecticut Valley Power Exchange. They give the generation hour by hour of the various plants in Connecticut which I have mentioned. They also give the hour load at Bristol.

Q The hour load? *A* The hourly load at Bristol. They do not give the [*2855*] hourly load at Winsted or at East Hampton. The loads at Winsted and East Hampton are, however, compara-

tively light. For the purpose of my studies it was not necessary to determine the hourly loads at Winsted and East Hampton. I satisfied the requirements of the study by taking in each month the largest amount of demand purchased at each of these places, that is, at East Hampton and Winsted, and adding these figures to the hourly load at Bristol. In that way I got larger loads than actually existed most, or perhaps all of the time; any how, I was on the safe side. As against the loads obtained each hour by this method, I compared the amount generated at the South Meadow plant in Hartford. For almost all of the hours during this entire period of four and a half years, I found that the total amount generated at the South Meadow plant alone exceeded the combined loads calculated in the manner which I have described. The only exceptions were a few hours between January 1, 1937, and July 1, 1937. As to those hours I made further study in order to ascertain whether there was generated during those periods enough at one of the other plants which had been mentioned, so that, added to the amount generated at Hartford, it would exceed the combined load for the hour in question. I found that in all such cases the total amount generated in the Connecticut plants did exceed the combined load for the corresponding hour.

* * * * * * [2857]

Q Have you a table showing the monthly peak loads at Winsted, that is, the largest amount of demand during single months, purchased by The Connecticut Light and Power Company for the Winsted district? *A* Yes.

Mr. Branch: I ask that this sheet, the original of which [2858] I hand to the reporter, the next copy of which I give to counsel for the Federal Power Commission; maybe I should have given the second copy to the Examiner, but I think the third is legible, so I give it to the Examiner—be marked Exhibit Number 86 for Identification?

Trial Examiner: The document will be so marked.

(Document referred was marked as Exhibit Number 86 for Identification.)

Mr. Branch: I offer in evidence Exhibit Number 86 for Identification.

Mr. Wahrenbrock: May I have just a moment, please?

Trial Examiner: You may.

Mr. Wahrenbrock: Aside from the continuing objection, I have no other objection to this exhibit.

Trial Examiner: The exhibit will be received in evidence as Number 86.

(Exhibit Number 86 for Identification was marked Exhibit Number 86 in Evidence.)

By Mr. Branch: *Q* Have you a table showing the largest amount of demand during single hours purchased by The Connecticut Light and Power Company from The Connecticut Power Company for the East Hampton district for the years '37, '38 and the first six months of 1939? *A* Yes.

Mr. Branch: I hand a sheet showing that which the witness [2859] has given me, to the reporter, and ask that it be marked No. 87 for Identification. I give the Examiner and Counsel for the Federal Power Commission copies.

Trial Examiner: It will be marked Exhibit No. 87 for Identification.

(Document referred to was marked Exhibit Number 87 for Identification.)

* * * * * *

Q Is Exhibit Number 87 for Identification the document which you prepared in regard to the East Hampton District about which I just asked you? *A* Yes, it is.

Mr. Branch: I offer Exhibit Number 87 for Identification in evidence.

Mr. Wahrenbrock: The same position as on 86.

Trial Examiner: The exhibit will be received as Exhibit Number 87. An exception will be noted for the Commission's counsel.

The same applies to the previous exhibits which were [*2860*] admitted over objection.

(Exhibit Number 87 for Identification was marked as Exhibit Number 87 in Evidence.)

By Mr. Branch: *Q* Do the log sheets of The Connecticut Valley Power Exchange show readings of reactive volt ampere meters? *A* Yes.

Q Do the log sheets indicate the direction of flow of the reactive volt amperes? *A* Yes.

Q Have you examined some of the log sheets of The Connecticut Valley Power Exchange to ascertain whether at any time they indicate that there was a flow of active energy into the C. P. lines there was simultaneously a flow of reactive volt amperes in the opposite direction? *A* Yes, I have.

Q Did you find that there were such times? *A* Yes.

Q Will you specify a few of the hours when that occurred?

* * * * * * [*2863*]

Q The question is whether you will specify some of the hours when that occurred, Mr. Hopper? *A* For example, on May 29th, 1940, during each of the hours from 7:00 P.M. until 11:00 P.M., inclusive the watt-hour meters indicated a flow into the C.P. Lines. During all these hours the meter registering reactive volt amperes indicated a flow in the opposite direction.

Q Is it true that during that four hour-period the watt-hour meter indicated a flow only to the C.P. lines and the meters registering reactive volt amperes indicated a flow only in the opposite direction? *A* That is correct.

[*2864*] *Q* I find I omitted some questions, but I can put them in now. Referring to any memorandum you have, and if necessary, to Exhibits 86 and 87, what was the peak load of The Connecticut Light and Power Company at Bristol since January 1, 1937? *A* The maximum peak was 16,560 kilowatts.

Q What was the largest amount of demand at any time since January 1, 1937 purchased by The Connecticut Light and Power

Company from The Connecticut Power Company for the East Hampton district? *A* 1,324.8 kilowatts.

Q What was the largest amount of demand purchased at any time since January 1, 1937 by The Connecticut Light and Power Company from The Torrington Electric Light Company for the Winsted district? *A* 1,952 kilowatts.

Q What is the total amount of these three peaks which you have given for Bristol, Winsted, and East Hampton? *A* 19,836.8 kilowatts.

* * * * * * [*2865*]

By Mr. Wahrenbrock: *Q* Will you describe what meter readings at the South Meadow substation you took in order to make the statement you made about reactive power? *A* On the Connecticut Valley Power Exchange log sheet, the column "To C.P. lines", gives the integrated hourly flow to Connecticut Power lines at that point. And the column just to the right of that a little bit, "C.P.R. k.v.a.", gives the indicated reading at the hour at that point also, that is, to the C.P. lines at South Meadow substation.

Q And were the latter the only readings you took into account? *A* Yes.

Q Now, when you say at that point, what point do you mean? *A* At the location of the metering current and potential transformers on the two 66 k.v. lines, at the terminal facilities at South Meadow substation.

Q Have you made any study of the facilities at the South Meadow substation to determine where those meters are connected to the circuits? *A* No, only in a general way, I am familiar with that point.

Q What basis of knowledge have you for knowing what those readings mean? [*2866*] *A* I inquired as to the meaning of those readings through Mr. Mayott and his assistants at the Connecticut Valley Power Exchange office.

Q How many meters are there from which the readings you

considered are taken? *A* Are you referring to the watt-meters or the R.K.V.A. readings?

Q The R.K.V.A. readings. *A* I merely understood that there is an indicating meter that indicates—

Q You understand there is one meter? *A* An indicating meter.

Q An indicating meter? *A* That is correct.

Q You don't know of your own knowledge whether there is more than one meter? *A* I don't know.

Q Do you know whether that meter is connected to the C.P. 1 line? *A*. I do not know.

Q Do you know whether it is connected to the C.P. 2 line? *A* I do not know. I merely understand from conversation with members of the Connecticut Valley Power Exchange organization—

* * * * * * [2867]

The Witness: I merely understood from conversation with members of the Connecticut Valley Power Exchange that the R.K.V.A. meter on the C.P. lines indicates the R.K.V.A., or R. kilowatt-volt-amperes that are flowing either in or out to the C.P. lines at that point.

Q Have you ever actually seen that meter? *A* No, I have not.

Q Or the connections to the lines? *A* No, I have not.

Mr. Wahrenbrock: Mr. Examiner, I move that the testimony that has been given by this witness on that point be stricken, on the basis of the cross-examination thus far.

Mr. Branch: I think that Mr. Miller has testified on the same kind of a basis. Evidently counsel for the Federal Power Commission felt it was all right for him to use these log sheets and meter readings, and I don't see why our witness cannot do the same.

Trial Examiner: I think the difference is there was some testimony that Mr. Miller knew where the meters were. The witness doesn't appear to know where the meters were. He is testifying entirely on information received. However, I will let the testimony stand. It may be supplemented, to make it understandable.

[2868] By Mr. Wahrenbrock: *Q* I understand you to say that—

Trial Examiner: An exception will be noted for Commission counsel on the motion to strike.

By Mr. Wahrenbrock: *Q* (Continuing) —that you have been told by somebody that those meters register instantaneous values? *A* The r. k. v. a. meter, I understand is the indicating-type meter.

Q Do you know whether such meters register instantaneous values or register the average of instantaneous values over a few consecutive cycles? *A* They average the instantaneous—they give the average of the instantaneous value over the cycle. It is not an instantaneous figure, it is just the average effective amperes.

Q Now, what do you mean by "effective"? *A* The effective current in an alternating current.

Q Are you talking about reactive current? *A* Yes, it is either reactive or active, the current part of it is fluctuating in cycles, 60 cycles per second, and the value of an ammeter or an r. k. v. a. meter at this point reads as the effective value of amperes, which is the root mean square of the sine curve.

* * * * * * [2869]

By Mr. Wahrenbrock: *Q* I understand that in the statement you make about the readings, it is based on your understanding of such meters generally, and not upon your personal knowledge of the particular meters here involved? *A* That is correct.

Q On your statement with respect to effective current, do I understand then that what this meter registers or what meters of this kind register is the average over a half-cycle of the current under consideration? *A* Yes, that is correct.

Q Then it is not an instantaneous value? *A* No.

Q Well now, I don't understand why you now say it is not an instantaneous value when I previously understood you to say it was an instantaneous value.

Trial Examiner: I didn't understand the witness to say that. I suggest that you check closely on his answers on that.

Mr. Wahrenbrock: It is my recollection, but I will leave it up to the witness to explain.

The Witness: Perhaps I can qualify it. When I spoke of indicating meters as giving an instantaneous reading, I was speak- [*2870*] ing in terms of longer than a cycle or so. When I was describing what the current device of either an ammeter or an r.k.v.a. meter read, we came down to smaller divisions of time and the effective ampere readings is what the meter reads but the current actually does fluctuate 120 times in one second. It goes through a positive maximum and a negative maximum; it completes a cycle and there are sixty of those cycles in a second.

Q Then the r.k.v.a. meters that you speak of are registering reactive current over several cycles in the course of which the reactive current reverses its direction several times? *A* That is correct.

Q Well now, if the reactive current reverses its direction several times, how can you say that the meter indicates direction? *A* Both the r.k.v.a. meter and a wattmeter indicate or read the current or watts, whichever may be the case. The wattmeter is reading the direct or the current in a certain phase angle. The r.k.v.a. meter reads the current at 90 degrees to that. So that the instantaneous values pass through zero on both meters but they are not in phase with one another, while the r.k.v.a. meter may be positive, in the direction to the neutral axis, the r. k. v. a. meter will be 90 degrees out of phase with that, or else negative.

Mr. Wahrenbrock: I don't have the benefit of an engineering [*2871*] education in examining you and I haven't had time to get the benefit of technical advice, so I have just got to ask you questions to try to understand this from what you say. I don't understand from the answer you have given, how a meter which is an r.k.v.a. meter which registers an average over several cycles, in the course of which the reactive current reverses its flow several times, can indicate direction of flow of a current which is alternatingly flowing in two directions. How can that current have a direction of flow on the average, or over a period of time? *A* The alternating current flowing along a line can be represented by two vectors.

Q When you get talking of vectors, I don't understand very well, and I am going to ask you to draw a little diagram so that maybe I can follow you.

* * * * * * [*2872*]

A (Continuing) Alternating current in amperes may be represented by two vectors. The current in phase and the current 90 degrees to it may represent the current vector. We often speak of the vector as the power vector, as the direct power that can be obained by any given circuit. The portion of that vector, the 90-degree portion, is the wattless power or component.

[*2873*] By Mr. Wahrenbrock: *Q* Does that complete your answer? *A* No. May I have your question again, please?

* * * * * *

Q Now, that is the pending question. Now, I would like you to read the answer to this point, if I may.

(Whereupon the last answer as above recorded, was read by the reporter.)

By Mr. Wahrenbrock: *Q* Now, have you completed your answer? *A* No, I haven't.

Q Will you do so? *A* The alternating current in a circuit can be represented instantaneously by vectors, a vector in phase and a vector at 90 degrees to it. The vector I have called in phase represents the power vector, and the vector at right angles to it is the wattless vector. These are instantaneous values, as I have mentioned before. Now, the effective current of each one is the root mean square of the sine curve of each current, so that the watt meter which is the effective amperes of the vector in phase, is the average value effective amperes of that vector; and the effective amperes of the wattless current [*2874*] is the vector which is 90 degrees to that, and would represent the current 90 degrees out of phase with the power current. So that, the watt meter reads the vector, so-called in phase, and the R.K.V.A. meter reads the amount in the amperes, or the effective amperes 90 degrees in phase to that.

Q Then, am I to understand that you say that there are two currents flowing in an alternating current conductor, one out of phase with the other, and the wattmeter measures one current and the R.K.V.A. meter measures the other current? *A* No. I said that the actual current flowing in a circuit may be resolved into two vectors, one a direct current, so to speak, and one the wattless current. One, the power current, and one the wattless current. They are not two currents. There is only one current, but it may be represented by two vectors, 90 degrees to each other.

Q And one of these vectors is the reactive power that you have been talking about? *A* That is correct.

Q And that reactive power isn't a current? *A* Yes, it is. Power is current times the effective voltage.

Q But I thought you said that this reactive power was a vector and not a current? *A* It is a current vector.

Q It is one of two vectors of a single current? [*2875*] *A* That is correct.

Q Now, you used the term "wattless power". What do you mean by "wattless power"? *A* It is a common phrase used by engineers to express that component of the total current which is out of phase by 90 degrees with the power current.

Q Well, does it mean power at all? How can it be power if it is wattless? *A* Well, that is merely an expression. The expression "wattless" is merely an expression. The term, I believe, at the present time is "reactive volt amperes".

Q You have made a statement as to your views as to opposite flows of active and reactive energy. Does the reactive energy have the power to do work in an electric appliance? *A*. No, it does not.

Q Well, then, this reactive thing isn't energy at all, is it? *A* It is not classified as energy, but it is always in existence in an A.C. current.

Q Well, here is what I mean to get at. I believe all of our experts on both sides are in agreement that energy is the ability to do work? *A* That is right.

Q I may phrase it roughly, but that is my lay concept [*2876*] of it. Now, if you have something here that can't do work, it isn't energy, is it? *A* You can express it that way.

Q Well, then, this R.K.V.A. measurement is a measurement of something that isn't energy, is that right? *A* Yes, that is right.

Q Well, then, now you spoke of things flowing in opposite directions. I say things because I am not sure what they are. I want to find out. I take it then that this reactive, whatever it is, isn't energy, so it isn't an energy flowing in an opposite direction from the active energy, is it? *A* It is not an energy flowing in the opposite direction, no.

* * * * * * [*2877*]

Q Now, I want to come back to what I asked you before, and which I heard you make a response in response to, but [*2878*] which didn't clear up the question that I had in mind, and that is this question of how, if these R.K.V.A. meters are measuring an average of something over several cycles, or a few consecutive cycles, they can be measuring something that is going in one direction, when the very statement of the fact that there are cycles indicates that that something is going in both directions, and if they are measuring the average, how do you say that they measure something that is going in a direction, a single direction? *A* In the current, alternating current, that is, on an A.C. circuit, it may be represented by a certain value in amperes. An ammeter put in that same circuit will read, say, or approximate, ten amperes. If the power factor of that particular circuit is eight tenths, then a watt meter would read not ten amperes times voltage, but eight amperes, and the energy current would be eight amperes. In that same hypothetical A.C. current, the r.k.v.a. meter would be reading approximately six-tenths, or six amperes, so that the watt meter would be measuring the effective current of only eight amperes, and the r.k.v.a. meter would be reading the effective current of six amperes, whereas the actual current measured by the ammeter will be ten amps.

Q You have been speaking of the watt meter, have you? *A* I was speaking of the watt meter and ammeter together.

[*2879*] *Q* Well, watt meters measure energy? *A* Yes, they measure energy, but they measure the component in phase, so to speak, with the voltage. That is, if a power factor of a circuit is eighth-tenths, the watt meter current element does not read ten amperes flowing in the actual circuit, flowing in the circuit, but it measures eight amperes, that portion that is in phase with the energy component.

Q Well, if I understand your statement then, the r.k.v.a. meter is measuring something, a different vector, and a different part of the phase, but how does that indicate a different direction of flow, of whatever it is that it is measuring? *A* The direction of flow has been indicated to me by the plus or minus signs on the k.v. log sheets. A current has to flow one direction or another, and the readings on the sheets of the r.k.v.a. meter are preceded by a plus or a minus sign.

Q Are you talking about currents or are you talking about energy? *A* I am talking about the current vector of the r.k.v.a. meter. The r.k.v.a. meter reads the product of the current and the voltage.

* * * * * * [*2880*]

SAMUEL FERGUSON,

previously sworn, resumed his testimony:

Cross Examination (*Resumed*) *by* Mr. WAHRENBROCK.

Q At the time we suspended the cross-examination, Mr. Ferguson, you had just referred to a bill or a copy of a bill that you had in your hands showing The Connecticut Power Company's method of billing The Connecticut Light and Power Company for Bristol deliveries, and The Hartford Electric Light Company's method of billing The Connecticut Power Company, with an indication "at Bristol" in connection with that billing. I wish to ask you if you referred to those two bills for the purpose of showing that the Exhibit 51, had been modified as of the date of those bill-

ings, and if you wish to suspend your answer until I can show you Exhibit 51, you may do so. I place Exhibits 51 and 8 before you. *A* That was not my object of referring to the bills. Exhibit 51 is a contract of a number of pages covering the terms and conditions, and I said that I did not know whether that had been modified or not. But in any case here was the bill covering a month in the period covered by that contract. I could not at this time check the bill against the terms of the contract, but that could be done by the billing department later, if it [*2881*] was desired.

* * * * * * [*2883*]

Q I ask you whether you now have any recollection of whether Exhibit 51 had been modified at the time Exhibit 8 took effect? *A* I think that it had because Exhibit 51 calls for an agreed [*2884*] 10,000 kilowatts. The balance of the load in Bristol, as it is recited, is to be furnished by The Connecticut Light and Power Company itself, from its own facilities. Now, the contract covered by Exhibit Number 8 assumes the total obligation at Bristol, which was necessary, inasmuch as prior to the date of that contract the lines of The Connecticut Light and Power company had been disconnected from those of The Connecticut Power Company, so that the entire contractual supply had to be furnished by The Connecticut Power Company, and that contractual supply that is covered in Exhibit 8 was backed, at first verbally, and later a reduction to writing, by The Hartford Electric Light Company and The Connecticut Power Company. The responsibility for the delivery of the power rested entirely on The Hartford Electric Light Company.

Q Yes. Now, do I understand then that prior to about June 1,—let me fix that date first. Was that approximately the date of the disconnection of the New Britain interconnection? *A* I don't think so. I think, if my recollection of dates is right, it was disconnected in August of 1935. It was prior to the Wheeler-Rayburn Act becoming the law of the land.

Q I believe, Mr. Ferguson, that the testimony in this case has

indicated that there was a disconnection of the New Britain interconnection at the time of the adoption of the [2885] Public Utility Act of 1935, but that with the restoration of The Connecticut Power Company's interstate connections, The Connecticut Light and Power Company shortly resumed its New Britain interconnection and that the New Britain interconnection was subsequently discontinued about June of 1936 and it was that second date that I was trying to fix, when the New Britain interconnection was last— *A* After the disconnection.

* * * * * * [2888]

Q Mr. Ferguson, have you refreshed your recollection so that you are able to state whether there was an interconnection of The Connecticut Light and Power Company and The Connecticut Power Company at New Britain, from the time of the enactment of the Public Utility Act of 1935 until about the first of June, 1936? *A* Yes. I wish to correct my former answer wherein I stated that the New Britain connection was not restored except on an emergency. I want to correct that to state that it was not restored except on emergency during any time that the Agawam connection was in operation, except for emergency periods. But during the periods that the Agawam lines were open, this interconnection was in existence, after August, 1935, until The Connecticut Light and Power Company were notified that the Agawam connection was to be restored, at which time the connection was once more opened.

Q And are you able to fix that date of the last opening of the New Britain interconnection? *A* The latter part of May, 1936.

Q Now, between August, 1935 and the latter part of May, 1936, was The Connecticut Power Company obligation to supply electric energy to The Connecticut Light and Power Company at Bristol backed up by any obligation on the part of The [2889] Connecticut Light and Power Company to supply electric energy to The Connecticut Power Company at New Britain?

* * * * * *

The Witness: Around that time there was a question of the continuance of the supply from Hartford as against Connecticut Light and Power Company building a line to Bristol, and operating it from their own facilities. The question of cost was an issue, and we decided to temporarily, inasmuch as both companies had surplus facilities, decided to split the load between Hartford and the facilities of The Connecticut Light and Power Company. This contract, Exhibit 51, recites that The Connecticut Power Company with the backing of Hartford would take the Bristol load up to 10,000. The Connecticut Light and Power Company would supply themselves the balance. It was not a case of backing the Connecticut Power Company. It was a case of furnishing power for their own territory, in the extent, as I recall, of about 3,000 furnished by their own facilities, and 10,000 from Hartford.

[2890] By Mr. Wahrenbrock: *Q* Then, do I understand that about the end of May, 1936, when The Connecticut Light and Power Company severed its interconnection at New Britain with The Connecticut Power Company's lines, no contractual arrangement was made for the supplying to Bristol of energy in lieu of that which The Connecticut Light and Power Company itself had previously supplied from New Britain? *A* You mean was there any duly executed contract, or do you mean understanding?

Q I mean to know what the facts are. *A* Why, of course, Hartford assumed that, as soon as they cut it, and told them they could carry it for them.

Q Was there any conversation on the point? *A* I presume so. I don't recall.

Q You have no recollection of any conversation? *A* I have no recollection of a conversation about it, but it was perfectly obvious they were going to cut it, and we assumed it. It was only a question of price. It was a question of not charging them for that 3,000 kilowatts, and the reason for not charging for that 3,000 kilowatts was that they had plenty of capacity back of

Bristol. They didn't need to buy the whole of the 13 being used in Bristol. As soon as the lines were cut, we had to take it all up. There was no question.

Q Then, the essential fact is that The Connecticut [*2891*] Power Company did deliver the energy, whether there was any agreement to do so, or any conversation about it, or not? *A* The Hartford supplied the energy to The Connecticut Power Company because at that time the arrangement with The Connecticut Power Company was that all its power was supplied by Hartford, and Hartford assumed the total responsibility and treated the Bristol and Torrington contract as Hartford contracts, for which The Connecticut Power Company was paid a transmission charge for delivering Hartford power to Bristol.

Q Then, instead of saying Connecticut Power, I will substitute The Hartford Electric Light Company, and ask you whether from the time of the discontinuance of the New Britain interconnection, the latter part of May, 1936, The Hartford Electric Light Company in addition to furnishing the power and the energy which it was obligated to furnish under the written contract, which is Exhibit 51, supplied— *A* That isn't the contract between Hartford, is it?

Q Exhibit 51 is between the Connecticut Power Company and the Connecticut Light and Power Company. *A* You said Hartford.

Q Now, let me understand what the facts were. Under Exhibit 51, The Connecticut Power Company was obligated to furnish up to 10,000 kilowatts. *A* Yes.

Q To the Connecticut Light and Power Company, and it [*2892*] did furnish energy in accordance with the terms of the contract, according to what you have previously said. Is that correct? *A* At the time you are speaking of, The Connecticut Power Company was under an obligation to deliver all of its own power to Hartford, and Hartford was under an obligation to The Connecticut Power Company to supply the entire requirements of its customers. The Hartford paid The Connecticut Power Company

the sum of $636,000 for the use of all the kilowatt hours of The Connecticut Power Company and the use of its facilities in the transmitting of Hartford power to points in the State.

Q Then, do I understand that while under Exhibit 51, The Connecticut Power Company was obligated to supply the Connecticut Light and Power Company's requirements at Bristol up to 10,000 kilowatts, that its obligations was discharged for it by Hartford? *A* Yes.

Q And after— *A* That obligation was assumed by Hartford. That might be a more correct way of stating that.

Q And after the end of May, 1936, Hartford supplied all of the requirements for Bristol, without a written contract, or without any conversation, obligating it to supply more than was referred to in Exhibit 51? *A* Well, it is very hard to deny a conversation. You [*2893*] see that I was the principal officer of both companies, and I had an obligation to myself, as president of The Connecticut Power Company, that I, as president of The Hartford Electric Light Company, should take care of their requirements.

Q Yes, but now—

Trial Examiner: A subjective contract.

By Mr. Wahrenbrock: *Q* I am not speaking of a contract between Hartford and Connecticut Power. I am speaking of a written contract or a conversation, or something verbal, a verbal agreement between either Hartford or the Connecticut Power on the one hand, and The Connecticut Light and Power Company on the other hand, with respect to the Bristol requirements above the 10,000 referred to in Exhibit No. 51. *A* There must have been a conversation. I have only denied recalling the conversation. But they couldn't have just disconnected the lines and hoped that the Lord would provide power.

Q Well, either the Lord or The Hartford Electric Light Company, or The Connecticut Power Company did provide the energy? *A* The Hartford Electric Light Company did provide energy, and

has been responsible for the energy from Bristol for years and years.

Q And at the present time, you are not able to recall [2894] any conversation or verbal agreement for the furnishing of that, aside from the mere fact that it was billed and paid for? *A* I can't recall any conversation.

* * * * * * [2897]

ARTHUR J. HOPPER, JR.,

a witness, previously sworn, resumed his testimony:

Cross Examination (Continued) by Mr. WAHRENBROCK.

Mr. Wahrenbrock: Shall I proceed?

Trial Examiner: You may proceed.

Q Mr. Hopper, as I understood what you were saying before the interruption of the cross-examination, r.k.v.a. meters are designed to register a vector, are they, that vector being 90 degrees out of phase with the active power vector? *A* Yes.

Q By 90 degrees do you mean a quarter of one complete circle? *A* Yes.

Q Are those two vectors, or are those two vector components active and reactive, are they vector components of the same flow of power? *A* Not exactly. The flow of power, the component, the vector, that results in work being done is the active vector, and the reactive, in conjunction with the two gives the algebraic [2898] sum of the two, the reactive and the active vector gives you the total k.v.a. which is, in the case of a circuit, the current measured in amperes times voltage of the circuit, will give us the k.v.a. of that circuit.

Q Now, as I understood your earlier testimony, these two vector components are not actual separate currents, is that right? *A* No, they are not actual separate currents.

Mr. Branch: I didn't hear the answer.

The Witness: No, they are not actual separate currents.

By Mr. Wahrenbrock: *Q* They are vector components of the same current, are they? *A* That is correct.

* * * * * *

Q What is a vector, as you use it? *A* A vector, as I use it, is merely an expression of direction of flow, in this case, current.

Q Did that complete your answer? *A* Yes, I believe so.

* * * * * * [2899]

Q Well, can you have a voltage vector? *A* Oh, yes.

Q Well, what is a voltage vector? *A* A voltage vector is a line indicating direction of flow which is usually marked with a different symbol other than the current vector. A current vector and a voltage vector are one and the same. They look the same, except you may put a little different designation on the current vector, to separate the two of them, to distinguish the two of them.

Q How can you speak of a flow of voltage? *A* Well, voltage and current in any given electrical circuit, A. C. circuit, can be represented by a voltage vector and that in turn must be represented additionally by a current vector, and the relationship of those two vectors determines the power factor of the circuit.

Q Well now, you can't say, can you, that a vector represents the direction of the flow of voltage? *A* No, not exactly.

Q Well, can you say that a vector represents the direction of flow of current, then? *A* Yes. I think so.

Q Well now, when you have these two component vectors, is the actual flow of energy the resultant of the two component [2900] vectors? *A* The actual flow of energy is not the resultant, no.

Q Well, is it accurate to say that the flow of current is the resultant of the two component vectors? *A* Yes, I would say so diagrammatically.

* * * * * *

Q Well, that is what the actual current is, isn't it? *A* That is what the actual current is.

Q And that is the only actual current there is? *A* That is correct.

Q Is the reactive power another way of designating the exciting current, or the magnetizing current? *A* Yes, it can be expressed that way.

Q Well, what happens to this magnetizing current, the magnetizing energy? *A* Pardon me?

Q What happens to the magnetizing energy that is supplied to the consumers' devices? *A* Did you say magnetizing energy?

Q Yes. Am I incorrect in my wording of this question? *A* I thought we called it magnetizing current, or current times voltage. It is not energy exactly.

[*2901*] *Q* Now, we have had reference to magnetizing energy? *A* Yes.

Q How do you relate that to magnetizing current? *A* It is current times voltage in the circuit will give us magnetizing energy.

Q What happens to the magnetizing energy when it is supplied to consumers' devices?

* * * * * * [*2904*]

Trial Examiner: The witness may answer. Note an exception to counsel for the respondent.

The Witness: The magnetizing energy is used up in numerous devices you find on consumers' premises. such as small transformers, or large transformers, motors—

By Mr. Wahrenbrock: *Q* And when you say used up, do you mean it is stored in them for a portion of a cycle and returned to the circuit? *A* That is as I understand it, yes.

Q And this same magnetizing current is stored in the transformer and returned to the circuit? *A* Yes, that is right.

Q And it is essentially a process of storing and circulating the energy which makes up that magnetizing energy? *A* Yes, I believe that is correct.

* * * * * * [*2906*]

Q The magnetizing energy then is an energy which is stored in the transformer and returned to the circuit and stored in the con-

sumers' appliances and returned to the circuit each cycle, is it? *A* Yes, I believe that is true.

Q I have been speaking in these last few questions of magnetizing energy.

Trial Examiner: Well now, are you going to relate this to this reactive current?

Mr. Wahrenbrock: I want to ask if the magnetizing energy is r.k.v.a.

The Witness: As I understand it, the sum of all your appliance magnetizing energy as a group all coming through to the main substation and thereupon appear as reactive current, yes.

[*2907*] *Q* As reactive current? *A* Reactive volt amperes.

* * * * * *

CLARENCE W. MAYOTT,

a witness, previously sworn, is called on behalf of the respondent and testified as follows:

Direct Examination by Mr. BRANCH.

Q What is your name? *A* Clarence W. Mayott.

Q Have you testified before in this case as a witness for the Federal Power Commission? *A* I have.

Q As Manager of The Connecticut Valley Power Exchange have you been familiar with the connections of the various generators in the generating plants of the Hartford Electric [*2908*] Light Company and The Connecticut Power Company in Connecticut since January 1, 1937? *A* Yes.

Q I didn't get the answer. *A* Yes.

Q What is the capacity of the South Meadow Steam plant? *A* At the present time it is 130,000 kilowatts.

Q Has that been the same ever since August 26th, 1935? *A* Yes, except that a 40,000 kilowatt unit was added and put in operation in September, 1938. Before that time the capacity was 90 kilowatts.

Q What is the capacity of the Hartford Electric Light Com-

pany's plant at Dutch Point? *A* 34,000 kilowatts; prior to the first part of 1937 it was 36,000 kilowatts.

Q The first part of '37? *A* 1937, yes, sir.

Q Has the Dutch point plant since August 26th, 1930 been connected in such a manner that it can be called upon for reserve capacity? *A* That is, for all intents and purposes the Dutch Point plant and the South Meadow plants could be considered as one plant.

Q Did you say the Dutch Point plant, and the South Meadows plants? [*2909*] *A* The South Meadow plant.

Q Has The Hartford Electric Light Company any other plant? *A* The Tariffville Hydro Plant with an installed capacity of 1,500 kilowatts. This capacity has been the same since August 26th, 1935.

Q The plants you have mentioned were the only plants which The Hartford Electric Light Company owns? *A* Yes, they are.

Q Only generating plants I mean, of course. Are the plants of The Hartford Electric Light Company, to which you have referred, all connected with C.P. lines 1 and 2? *A* Yes.

Q What plants of The Connecticut Power Company are connected with C.P. lines 1 and 2? *A* The Falls—

* * * * * * [*2910*]

Mr. Branch: Well, are you familiar with the plants, and their capacities?

The Witness: I am. My interpretation of your question was "the plants".

By Mr. Branch: *Q* What plants of The Connecticut Power Company are connected with lines 1 and 2? *A* The Falls Village hydro plant with an installed capacity of 9,000 kilowatts and a capability of 11,000 kilowatts and the Unionville hydro plant with an installed capacity of 1,600 kilowatts. These figures are the same for all times since August 26th, 1935.

Q Were all generating units, when generating, in these plants of the Hartford Electric Light Company and The Connecticut

Power Company connected to C.P. lines 1 and 2 at all times between January 1, 1937 and July 1, 1937? *A* Yes, except for short periods when line disturbances might have separated the system.

Q Was any interruption as to which you have referred of any considerable duration during that period? *A* No. The maximum is of a few minutes duration.

[*2911*] *Q* Have such interruptions been frequent or infrequent? *A* Very infrequent.

Q Have all generating units of The Hartford Electric Light Company at South Meadow and Dutch point when generating, been connected at all times to the C.P. lines 1 and 2 since January 1, 1937? *A* Yes, except for short and infrequent periods of interruptions due to line disturbances.

Q What was the maximum of those disturbances or interruptions? *A* Just a few minutes.

Q Mr. Mayott, will you please state the annual peak loads on The Hartford Electric Light Company and The Connecticut Power Company's interconnected system for the years 1937, 1938, 1939 and 1940 and the date in each year in which those peaks occur?

Mr. Wahrenbrock: I object to the answering of that question, Mr. Examiner. It hasn't any relevance to any issue in this proceeding. I have kept still without objecting to the line of testimony up to this point, because I realized that it was consistent with a point of view which the respondent is urging, but which, in my opinion, has no relevancy. Here I don't even understand this is relevant to any issue of proof which they have been thus far presenting in this case.

Trial Examiner: Will you state the purpose for which you [*2912*] desire to—

Mr. Branch: I think it is important to show, particularly in view of Mr. Ferguson's testimony, as to the obligation of The Hartford Electric Light Company with The Connecticut Power Company's assistance, to supply these loads of our plants, to show the capacity of those loads, and also to show that they are able to take care not only of our loads, but also of all other loads to which

they are connected, the point being that these plants alone are sufficient to take care of all of these loads at all times. That, I think, is an important point in the picture, and it will only take a minute to develop it. I have only two questions.

Trial Examiner: The size of the plant may be relevant. The question of materiality may be determined later by the Examiner.

Mr. Wahrenbrock: May I make just this point, Mr. Examiner, in that connection? As long as there is interstate commerce and interstate transmission, it doesn't make any difference whether if I am a local dealer I have got enough customers and I have got enough supplies so that I could supply them locally if, as a matter of fact, I do supply them from out of the State. What I do locally is immaterial.

Trial Examiner: The evidence will be admitted. The objection is overruled. Note an exception for Commission counsel. *A* For 1937, the date was November 22nd and the peak was [*2913*] 100,000 kilowatts. For 1938 the date was December 28th and the peak was 106,000 kilowatts. For 1939 the date was December 20th and the peak was 118,700 kilowatts. For 1940 the date was December 23rd, and the peak was 134,000 kilowatts.

By Mr. Branch: *Q* Will you also give the capability of the Hartford Electric Light Company-Connecticut Power Company's generating plants and their interconnected systems in kilowatt hours on those same dates? *A* In 1937, the capability was 140,500 kilowatts. In 1938 the capability was 180,500 kilowatts. In 1939 the capability was 180,500 kilowatts. In 1940 the capability was 180,500 kilowatts.

Q What if anything does a comparison between the peaks and the capabilities show, as to the necessity of relying on plants other than those in Connecticut, to satisfy the commitments for firm power of the system? *A* A comparison of each peak with the corresponding capability shows that the Hartford Electric Light Company has never in the period covered found it necessary to rely on plants other than those in Connecticut, to satisfy its commitments for firm power.

[2914] *Q* The years that you have given don't include 1935 and 1936. What was the situation with respect to capability and yearly peaks between August 26th, 1935 and the period which you have already given th figure for?

Trial Examiner: Will you read the previous question back, and the answer?

(The record is read by the reporter.)

Trial Examiner: In other words, that statement means that there was sufficient there, in other words, it wasn't physically necessary, is that your answer?

The Witness: It wasn't physically necessary to take any power from out of State.

Trial Examiner: All right.

Mr. Branch: Have you the next question?

Trial Examiner: Read the next question again.

(Pending question read by the reporter.)

A I do not have the figures before me for these years. In the course of my duties as manager of the Exchange, however, I have had to keep in touch at all times with these matters, and can state positively that at no time since August 25, 1935, has The Hartford Electric Light Company had to rely upon plants other than those in Connecticut, to satisfy its commitments for firm power. Between August 25th, 1935 and March 18th, 1936, there was no out-of-State connections between Hartford Electric Light Company-Connecticut Power Company interconnected systems.

[2915] During the remainder of 1936 with the exception of a short period when the South Meadow plant was flooded and being reconditioned, there was plenty of generation in the Connecticut plants to take care of the load at all times.

* * * * * *

Q You said in answer to the question, Mr. Mayott, between August 25th, 1935 and March 18th, 1936 there was no out-of-State connection between The Hartford Electric Light Company-Connecticut Power Company interconnected system. Do you mean

by that that The Hartford Electric Light-Connecticut Power System was not connected with any out-of-State line? *A* That is correct.

* * * * * *

Q Mr. Mayott, when you previously testified, I think you gave the date at which The Connecticut Light and Power Company disconnected the connection which had been established at New Britain during that time of the flood, in 1936. Will you now [*2916*] describe what happened at about that time and how long the emergency lasted, and so forth? *A* During the second week in March, 1936, a long period of warm weather combined with extra heavy warm rains caused excessive floods on the Connecticut River and other streams in Connecticut and Massachusetts. By Wednesday, March 18th, some minor dams had been washed out and the Connecticut River was rising so rapidly that it was apparent that the power situation was becoming critical. On March 18th I was asked by Mr. C. F. Mosher, General Superintendent of the Turners Falls Power and Electric Company—I will have to make a correction. I was notified by Mr. C. F. Mosher, General Superintendent—

* * * * * *

A (Continuing) I will go back. On Wednesday, March 18th, I was notified by Mr. C. F. Mosher, General Superintendent of the Turners Falls Power and Electric Company that the New England Power Company's hydro plant at Vernon had already been shut down by high water; that it would be only a short period of time before their cap on the station would be flooded out; that a landslide was threatening the power supply from Cobble Mountain, and asked to have the Hartford-Agawam line reconnected on an emergency basis. [*2917*] The officials of The Connecticut Power Company and The Connecticut Light and Power Company were immediately notified and gave their approval for the reconnection on an emergency basis. At 1:32 P.M., on March 18th, 1936, the

Hartford-Agawam C-3 was put back in operation, and at 1:54 P.M. the Hartford Agawam D-4 was put back into operation.

During the next 24 hours I was notified that the Hampden steam plant of the Turners Falls Power and Electric Company, the Springfield steam plant of the United Electric Light Company, and the Dutch Point plant of the Hartford Electric Light Company were flooded out, in the order given. With a few hours of the Dutch Point plant being flooded, the water had risen so high that it was necessary to start shutting down the South Meadow plant. South Meadow was flooded. The last unit at South Meadow was back in service April 17th, 1936, but of course it was not certain at that time that the equipment was completely reliable, due to the immersion and the necessary haste in which it had been reconstructed. Reconditioning at the Dutch Point Plant was not completed until December, and not until then can it be said that the emergency was ended.

[*2918*] *Q* That is, December, 1936? *A* December, 1936.

Q Mr. Mayott, I think in response to some questions of Mr. Wahrenbrock when he called you as a witness for the Federal Power Commission, you testified that one of your duties as manager of the Exchange, was to prepare a schedule indicating the most economical program of generation for the Exchange for the ensuing twenty-four hour period. Do you recall instances where such schedule was not followed? *A* Yes.

Q Were those instances frequent? *A* Yes.

Q Will you state the reasons why the schedule wasn't followed? *A* Changes in load from that predicted, changes in the available capacity and line outages.

* * * * * * [*2919*]

JOHN M. KRAMARSIK,

a witness called on behalf of the Respondent, being first duly sworn, testified as follows:

Direct Examination by Mr. BRANCH.

Q Will you state your name? *A* John M. Kramarsik.

Q Will you give your home address and business address. *A* My home address is 19 Dartmouth Avenue, West Hartford; business address, 36 Pearl Street, Hartford, Connecticut.

Q Are you an official of The Connecticut Light and Power Company? *A* I am one of the assistant secretaries of The Connecticut Light and Power Company.

Q Have you had an investigation made to determine whether at any time since August 26, 1935, The Connecticut Light and Power Company has owned any stock in either The Connecticut Power Company or The Hartford Electric Light Company?

* * * * * * [*2920*]

By Mr. Branch: *Q* And what did your investigation reveal?

* * * * * *

[*2921*] The Witness: The Connecticut Light and Power Company has at no time since the date you mention had any stock ownership in any of the companies that you mentioned.

By Mr. Branch: *Q* And has either of those companies, The Connecticut Power Company or The Hartford Electric Light Company, owned any stock in The Connecticut Light and Power Company during this period?

* * * * * *

The Witness: The answer is no.

By Mr. Branch: *Q* Have you also made an investigation to determine whether any person has served simultaneously as an officer of The Connecticut Light and Power Company, on the one hand, and either The Connecticut Power Company or The Hartford Electric Light Company on the other hand?

* * * * * *

The Witness: There have been no common officers or directors.

[*2922*] By Mr. Branch: *Q* No common officers or directors; you mean between The Connecticut Light and Power Company, on the one hand, and either The Connecticut Power Company or

The Hartford Electric Light Company on the other hand? *A* That is correct.

* * * * * * [*2931*]

PROCEEDINGS.

Trial Examiner: The hearing will be in order. The Trial Examiner has reviewed some of the rulings which were reserved. Exhibit No. 52 is rejected, contract not being shown to have been in force subsequent to the enactment of the Federal Power Act.

Mr. Branch: May I ask who offered that in evidence?

Trial Examiner: That was offered by Commission counsel.

Mr. Branch: Very well.

Trial Examiner: It was originally offered on the 15th of July.

Mr. Davis: That is Exhibit 52?

Trial Examiner: Exhibit 52. The original references to it on page 997—that is where the offer is made.

(Exhibit 52 was rejected.)

Trial Examiner: Exhibit No. 71 will be admitted.

Mr. Wahrenbrock: I am sorry, I did not hear your ruling.

Trial Examiner: I said Exhibit No. 71 will be admitted.

Mr. Branch: That was offered by Commission's counsel.

Trial Examiner: That was offered by Commission's counsel. I was in error last night when I was under the impression it had been offered by the respondent.

Mr. Branch: My recollection is that I objected to that, and consequently I should like to have an exception noted.

[*2932*] Trial Examiner: You did object to it, and you may have an exception. I may say that other evidence along the same line has been introduced at the request of the respondent.

(Exhibit 71 for Identification received in evidence as Exhibit 71.)

Trial Examiner: Exhibit No. 44-C will be rejected. It is not apparent that the respondent knew of this before it was submitted to the Commission. Exhibit No. 44-E will be admitted.

Mr. Branch: And I think I objected to the admission of that, and I should like to have an exception noted.

* * * * * * [2934]

CHARLES F. SCOTT,

a witness called on behalf of the Respondent, being first duly sworn, testified as follows:

Direct Examination by Mr. BRANCH.

Q What is your name? *A* My name is Charles F. Scott.

Q Where do you reside? *A* New Haven, Connecticut.

Q What is your occupation? *A* I am Professor of Electrical Engineering, Emeritus, Yale University.

Q Will you please state your education and experience as an electrical engineer? *A* I graduated from the Ohio State University in 1885 and during the next two years continued my studies at that institution and at Johns Hopkins University, Electrical subjects being prominent. After some experience as a wireman, I entered the testing room of what is now the Westinghouse Electric and Manufacturing Company in Pittsburgh. Shortly afterwards I became a Laboratory [2935] Assistant. The Westinghouse Company, then in its second year, was developing the alternating current system which was then limited to incandescent lighting, as there was no alternating current motor, and there was no house meter for registering consumption. About the time I went to Pittsburgh in 1888, the Shallenberger meter for alternating current and the Tesla motor for alternating currents were both announced, and a general development of facilities for use with the alternating current system followed. Mr. Tesla's patents were acquired by Mr. Westinghouse and Tesla was at the works, developing the motor. I was assigned as an assistant to him. I worked under his direction and then had charge of developments in this line. I introduced certain modifications in his motor and designed a generator for operating a coal-mining machine by these motors, which I believe was the first commercial installation of the Tesla motor. I worked with Mr. Tesla for about a year.

One incident in my early experience was the testing of a pair of alternating current machines of a new type. I ran one as generator and the other as motor, both with load and without load. I learned the characteristics of the synchronous motor and also operated it as a synchronous condenser. Shortly after this experience a synchronous motor plant [*2936*] of 100 horsepower was sold, and I was given charge of the assembly of the equipment and describing and developing the apparatus for starting and for control.

This plant, the first of its kind, was installed about 1891 at Teluride, Colorado. I became Assistant Electrician and later Chief Electrician, and later Consulting Engineer of the Westinghouse Company. I had contacts with many lines of work, as well as with different kinds of specific apparatus. One of the memorable developments of the Company was the Tesla polyphase alternating current system. This had characteristics which radically changed the whole commercial electrical field, and its initial large-scale installation was at Niagara Falls. During the 80's, various electric systems had developed. Several systems for arc lighting, the Edison system for incandescent lighting, limited to about a half mile radius, the early alternating current for long-distance incandescent lighting and a current for operating street-railway motors. These various kinds of current were produced by dynamos of different types and their circuits were entirely independent. In 1890 very few machines exceeded 100 horsepower in capacity.

Trial Examiner: Just a moment, Mr. Scott. I don't believe that Commission counsel is able to hear you.

Mr. Davis: Because of the train, Professor Scott, making such a noise at the moment.

[*2937*] (Temporary suspension.)

A (Continuing) One of the memorable developments of the Company was the Tesla polyphase system. This had characteristics which radically changed the whole commercial electrical field and its initial large-scale installation was at Niagara Falls. During the 80's, various electric systems had developed, several systems

for arc lighting, the Edison system for incandescent lighting, limited to about a half-mile radius, the early alternating current for long distance incandescent lighting, and the current for the operation of street railway motors. These various kinds of current were produced by dynamos of different types and their circuits were entirely independent. In 1890 very few machines exceeded 100 horsepower in capacity. At Niagara Falls a larger power development was proposed and various systems of transmission were suggested. The Tesla system was proposed by the Westinghouse Company and I, with other engineers, engaged in the development of methods and apparatus. After the first contract for generators at Niagara had been placed, which involved two-phase machines, it was found desirable to make the transmission to Buffalo three-phase. I devised a method of transformer connection by which the power from the [*2938*] two-phase generators could be transmitted by three-phase at a greater economy, to Buffalo, and this system was adopted and used.

By Mr. Branch: *Q* Are these connections what are commonly known as the Scott connections? *A* Yes.

Q Will you continue with your description of your experience? *A* I continued having a consulting part with the early problems of Niagara, making visits to Niagara and aiding in tests over a period of several years. Later on I was interested in the development of single-phase railway systems. I came from Pittsburgh to the Professorship of Electrical Engineering at Yale in 1911. Since coming to Yale I have acted as consultant or expert for the Westinghouse Company and the General Electric Company, the New Haven Railroad, the Niagara Power Company, the Telephone Company and others. For the Telephone Company I made a visit to Italy to determine the conditions in the placing of a long distance telephone cable so as to avoid inductive disturbance from a railway which was about to be electrified. I note that a list of papers presented before the American Institute of Electrical Engineers prior to 1900 includes five papers under the heading of "Power Transmission". The first and [*2939*] the last of these

carry my name. I was President of the American Institute of Electrical Engineers in 1902, '03, and have kept active in connection with it ever since. In its Transactions are papers which I presented, and I wrote voluminously for the Electric Journal, which I originated and for a number of years directed while I was with the Westinghouse Company. I became Professor Emeritus at Yale in 1933. I have been Chairman since its organization in 1935 of the Connecticut Board of Registration for professional engineers, and land surveyors, and last Friday was re-elected for the coming year. Two years ago I served a term as President of the National Council of State Boards of Engineering Examiners.

Q Do the terms "transmission" and "local distribution" have generally accepted meanings in the electrical power industry? *A* Yes.

Q Are you familiar with the generally accepted meanings which those terms have in that industry? *A* I believe I am.

Q Did those terms have the same generally accepted meaning in 1935 as they do now? *A*. I believe so.

Q What is the basis of your familiarity with those terms [2940] as used in the electric industry? *A* My long-term technical and general interest in electrical power and the giving of instruction in the subject until I retired as a teacher, in 1933. Since then I have not been actually teaching, but have kept myself posted on the developments in this field, in much the same manner as prior to 1933.

Q Will you explain the meanings of those terms, "transmission" and "local distribution," as generally understood and used in the electrical industry? *A* "Transmission"is generally used to apply to the conveying of large units of power over considerable distance at high voltage to localities where it is to be utilized. The distribution function is to deliver this power—

Mr. Wahrenbrock: Can we have just a moment? Not quite so fast. I would like to make a few notes, as you go along. May I have the reporter read the part of the answer which has already been given?

Trial Examiner: Will the reporter read back that portion of the answer already given?

(The portion of the answer is read by the reporter.)

[*2941*] By Mr. Branch: *Q* Will you continue. *A* The distribution function is to deliver this power in suitable form for use by industries or in domestic service or otherwise.

Q Is there any clearly defined line of demarcation in the generally accepted use of these terms, between "transmission" on the one hand, and "local distribution," on the other? *A* The distinction is rather one of function than of definite of quantities. There is, for example, no particular distance or no particular voltage or amount of power which may be distinguished one from the other. What in one place and under certain circumstances might be properly considered as transmission may, under other circumstances, employ greater power or greater distance, or greater voltage in what is termed a distribution system. Distribution obviously cannot be predicated upon the voltage employed. 220 volts may be adequate for a few city blocks, but not for a city. 2300 volts may serve a city of certain dimensions, but would not be adequate for rural electrification to farmers and scattered hamlets. Broadly, the terms "distribution" and "transmission" are relative terms. A transformer may supply the various residences and stores in a city block. Here the distribution is at, say 110 or 220 volts, and the 2300 volts primary circuit [*2942*] to the transformer may be called a transmission line from the city station. Furthermore, the circuits to the several parts of the city may be considered as the distributing circuits, which are in turn supplied by an incoming circuit at, say, 13,000 volts, which relatively might be called a transmission circuit.

Again, the 13,000 volt circuit may supply a number of localities from a substation, which in turn receives its power from a 66,000 volt circuit. In this case, the 13,000 volt circuit performs a distributing function, and the 66,000 volt circuit is a transmission circuit which delivers power by wholesale to be distributed through various circuits as may be economical and appropriate for serving

the residences and other customers. Hence, if we attempt to classify one link in the system by relating it to an adjacent link, we encounter the dilemma of finding that it might appear more like transmission if we compared it to the link toward the consumer, and distribution if we compared it with the link toward the source of power. A valid classification, therefore, must contemplate everything between the generator and the ultimate consumer. Of course, all circuits actually transmit power, but the term "transmission," from the engineering viewpoint, is primarily associated with the source of power, whereas "distribution" is primarily associated with the destination and employment of [2943] electric power. At the source—

Trial Examiner: Will you suspend a moment?

Mr. Wahrenbrock: Before the witness continues, may I have the last two or three sentences read?

Trial Examiner: The reporter will read the last two or three sentences for the benefit of Commission's counsel.

(Whereupon the last three sentences of the answer as above recorded, were read by the reporter.)

The Witness: At the source, the kind of current adapted must be suited to large scale production and to long distance transmission. At the destination, the needs of the consumer dictate the kind of current. It must be suited for lamps or motors or furnaces, or electroplating, or other uses to which electric power is put. Hence, in dividing an actual system into two divisions, namely, transmission and distribution, the classification should logically be made on the basis of function performed. Facilities are designed, on the one hand, with an eye to the power source, and the problem of long distance, high voltage transmission; and on the other hand, with an eye to the problem of supplying the particular needs of customers in the most efficient and economical fashion, in view of the particular geographical and local conditions. Ordinarily, in the region hereabout, the facilities by which large units of power at wholesale are transmitted from a [2944] source at 66,000 volts across country to steel towers, were designed

to fulfill the transmission function and the facilities of the purchaser by means of which the voltage is reduced and put in process of delivery to customers of various types and groupings were designed to fulfill the function of distribution.

Mr. Wahrenbrock: May I have that last sentence read again, please?

Trial Examiner: The last sentence will be read for benefit of Commission's counsel.

(The last sentence of the answer as above recorded, was read by the reporter.)

By Mr. Branch: *Q* Will you continue? *A* Ordinarily, therefore, since transmission logically ceases where the wholesale delivery of power occurs, and the further facilities have close relation to the delivery of power to the retail customer, the classification of an actual system into two divisions should be made at that point, so that the substation and circuits emanating from it would be included within the term "distribution".

Q I am going to read to you a quotation from the testimony of Mr. Thomas, it being a statement which he made in making a distinction between the terms "distribution" and "local distribution". This is the statement:

> "Distribution of energy in a utility system is a sub- [2945] dividing of the bulk energy delivered to the neighborhood among the various customers. Local distribution narrows the operation down to a group of consumers so closely associated as to use common distribution facilities without the necessity of considering the element of transmission between members of the group."

That is the end of the quotation. What have you to say in regard to the distinction indicated in that statement? *A* I cannot agree that it is a recognized distinction. In my experience, there is no such generally accepted distinction between the terms "local distribution" and "distribution". I regard the word "local" as

conveniently descriptive of distribution as contrasted with the term "long distance", when applied to transmission.

Q Are you familiar with the facilities of the Connecticut Light and Power Company in and about its substation at Bristol? *A* Yes. I have personally visited the station, and as a result of my examination have, believe, a correct idea of the various types of apparatus and their function. I have also examined Exhibits No. 28, 82, and 38.

Q Those numbers refer to Exhibits which are in evidence in this case? Are they, Professor Scott? *A* I so understand.

Q Assuming, as has been testified in this case, that all of the apparatus in the Bristol substation beyond the strain [*2946*] insulators at the end of the Connecticut Power transmission line, except certain apparatus connected with the operation of certain circuit breakers at Bristol Mountain to Tower 474 is owned by the Connecticut Light and Power Company, in your opinion as an engineer, on the basis of your explanation of the term, should those facilities of the Connecticut Light and Power Company in and about the Bristol substation properly be classified as facilities for transmission or as facilities used in local distribution? *A* In my opinion, they are facilities used in local distribution.

Q Will you explain? *A* The principal facilities in the substation at Bristol are the transformers and the synchronous condenser. These facilities seem to me to be clearly a part of the local distribution system. The transformers have been designed to supply energy at two particular voltages which are suited to the requirements of the Bristol distribution system. The transformers, as I understood, were specified by the engineer of the Connecticut Light and Power Company to meet the particular conditions and requirements of this distribution system. This, to my mind, makes their design, installation, and operation for the specific purposes, and to meet the specific requirements of a distribution system. Certain apparatus, including the lightning arrestors and the switches are for the protection and oper- [*2947*] ation of the transformers, and are therefore simply auxiliary to them. The

synchronous condenser performs two functions directly related to the distribution system. The first of these is the maintenance of a steady voltage on the distribution system; the second function of the synchronous condenser may be illustrated as follows: Induction motors require for their operation two kinds of current. One is a magnetizing current required when the motor is loaded, and also when it is running empty. The other is the power current which varies in proportion to the power delivered by the motor. The synchronous condenser produces the magnetizing current which is necessary to the proper operation of the distribution system, and therefore is an element in the local distribution system. Thus, the transmission properly ends with the termination of the Connecticut Power Company's line.

By Mr. Branch: *Q* Are you familiar with the facilities of The Connecticut Light and Power Company in what has been called the East Hampton district? *A* Yes. I have made careful study of the maps and diagrams in evidence as Exhibits 26 and 39.

Q 39? *A* 38. And have read the testimony of Mr. Colvin, starting on page 1795, and Mr. Thomas, starting on page 1290 and again on page 1356.

[*2948*] *Q* In your opinion as an engineer, are the facilities of The Connecticut Light and Power Company in that East Hampton District facilities used in local distribution, based on your explanation of the meaning of that term? *A* I consider them as facilities used in local distribution. In its simplest form—

Q Just a minute. Have you anything particular to say about the Leesville Generating Plant? *A* It may be considered as a part of the power production or generating system, and is a relatively small element in the general system.

Q Will you explain why you consider the other facilities as facilities used in local distribution? *A* In its simplest form, transmission is found in a circuit from a distant water power and distribution in the substation in which the voltage is reduced and current is supplied through radiating circuits. In modern extended power systems, however, there may be several links or stages between

source and consumer, in order to meet the actual conditions by the most economical methods. Successive circuits, for example, may be operated at 66,000, 13,000, 2,300 and 220 volts. An intermediate section may seem to be distribution to what immediately follows and transmission—I will correct. An intermediate section may seem to be distribution to what immediately precedes and transmission to what immediately [*2949*] follows, but its true function is its function in the system as a whole. Is the primary function, therefore, to distribute and deliver power in large units or is it for delivering to the consumers the wholesale power in the particular form which they need?

Q Just a minute. Mr. Scott, I think you said, you phrased that question: "Is it the primary function to distribute and deliver power?" Is that what you mean to say? *A* What I intended to say was, to ask the question: "Is it the primary function to transmit and deliver power in large units or on the other hand is it for delivering power to the consumers, which is received in wholesale and distributing this power then to the consumers in the form which they need?"

Q Will you continue with your explanation? *A* If the latter, the function is distribution, although the specific conditions may be most economically met by employing different voltages in different parts of the system, an engineering expedient which does not change its function. At the substation in Middletown, the 66,000 volt circuit terminated, and the energy was transformed to about 4,000 volts and 13,000 volts. From that substation several circuits emanated, from one of which customers in Middletown were served. Furthermore, from the substation in Portland, various circuits supplied factories at about 13,000 volts and commercial and [*2950*] domestic consumers at about 4,000 volts. The circuit which ran from the substation in Portland to Pole No. 110, a distance of nearly a half mile, was tapped to serve residential customers. Thus it appears that even before the energy had reached Pole No. 110 at which the facilities of The Connecticut Light and Power Company began, it had been transformed into two different

voltages and supplied over various circuits to many customers of different types and different locations. From Pole 110, where the energy was metered, the energy went to two substations of The Connecticut Light and Power Company at about 13,000 volts. One of these was the Collins Hill substation and the other the West High substation, both of which customers of the company were served; from the West High substation circuits operating at about 13,000 volts went to various substations from which customers were supplied, including the Leesville substation and those at Comstock Bridge, Westchester and Colchester. Looking at the matter as it is regarded in the industry, some of the points I note are as follows: Clearly the main purpose of this line was to make energy available to many customers in scattered groups. The system is in the country. Its function is distribution to ultimate consumers; since it is in the country we naturally expect that the distances between customers will be greater than in an urban [*2951*] area. These distances between customers do not alter the characteristics, which are distribution. I notice that the voltages about 13,000 volts and 2,300 volts, are characteristic of distribution. In a thickly settled city, where voltages are used for distribution, these values are found. We have here a system which is like the distribution in the City, except that it is spread out. In general, moreover, the lines have the characteristic of ordinary distribution lines.

Q Professor Scott, you have talked about the lines and have expressed your opinion generally about the facilities. Would your characterization of the facilities in this area, as facilities used in local distribution, include the substations which you have mentioned, belonging to The Connecticut Light and Power Company with the transformers and other incidental apparatus? *A* Yes. I regard the system including these substations and the lines to them and the lines from them, as being devised and planned from the standpoint of reaching the customer, and from the general classification which I gave when it is the needs of the customer and the

circuit for supplying those particular needs, I class that as primarily distribution.

Q Are you familiar with the facilities of The Connecticut Light and Power Company in the Torrington-Winsted District? *A* Yes, I have made a study of the maps and diagrams in [*2952*] evidence as Exhibits 27, 38 and 79, and have read the testimony of Mr. Colvin starting on page 1776 and the testimony of Mr. Thomas, starting on page 1298, and the other testimony starting on page 1318.

Mr. Wahrenbrock: May I have those exhibit numbers again?

Trial Examiner: Is that other testimony of Mr. Thomas on page 1318? You said "the other testimony on page 1318." Is that other testimony of Mr. Thomas's?

The Witness: Correct.

Mr. Branch: May I proceed?

Mr. Wahrenbrock: I would like to have those exhibit numbers, please.

Trial Examiner: The witness has not answered my question yet, as I understand it.

The Witness: I said "Correct."

Mr. Wahrenbrock: May I have those exhibit numbers that you just gave?

Trial Examiner: Will you state the exhibit numbers again?

The Witness: 27, 38 and 79.

Mr. Wahrenbrock: Thank you.

By Mr. Branch: *Q* Now, I think you were interrupted, Mr. Scott. Will you indicate the pages on which the testimony you read was, again,—all the different groups? *A* The testimony of Mr. Colvin starting on page 1776, the [*2953*] testimony of Mr. Thomas starting on page 1298, and the other testimony of Mr. Thomas on page 1318.

Trial Examiner: We will suspend a moment, please.

(Temporary suspension.)

By Mr. Branch: *Q* I think we haven't yet got the thing complete. Have you also read some testimony of Mr. Hughes? If

so, what testimony? *A* I have a reference in my notes to certain pages of Mr. Hughes' testimony, but at the moment I do not directly recall having read those sections, in addition to the others.

Q In your opinion as an engineer are the facilities of The Connecticut Light and Power Company in the Winsted-Torrington District facilities for transmission or facilities used in local distribution, based on your explanation of those terms?

Mr. Wahrenbrock: Mr. Examiner, before that question is answered, I would like to interpose an objection to that question and to the examination of this witness on the character of the facilities at Torrington and Winsted, on the ground that his study is based upon some not well-defined testimony of Mr. Hughes' and I submit that the status of the record with respect to the testimony of Mr. Hughes on the facilities of The Connecticut Light and Power Company at Torrington is—

Trial Examiner: Are you talking now about Torrington or [*2954*] Winsted?

Mr. Wahrenbrock: Torrington. It is in such a shape that that requires an appraisal and a weighing which is a function of the Commission, and not of a witness who is put on.

Mr. Branch: I think, Mr. Examiner, Mr. Wahrenbrock misunderstood. I understood the witness to say that he did not, although he had some references in his notes, he wasn't basing it on testimony of Mr. Hughes.

Trial Examiner: I understood the witness to say that he did not recall having read the testimony of Mr. Hughes.

Mr. Wahrenbrock: My understanding was that his notes indicated that he had, but he couldn't say which portions. I think that should be definitely cleared up.

[*2955*] Trial Examiner: Mr. Scott, do I understand that you did read the testimony of Mr. Hughes, or just a portion of the testimony of Mr. Hughes?

The Witness: I may explain by saying that there are quite a number of these references, both to the diagrams and to the testimony, and that in looking over this testimony I read quite a

number of these, some of these references covering several pages, and that my memory at the moment does not serve me as to whether I actually did read Mr. Hughes's testimony or not, so that I have refrained from making a positive statement that I had.

By Mr. Branch: *Q* Very well. In your opinion as an engineer, are the facilities of the Connecticut Light and Power Company in the Winsted-Torrington district, facilities for transmission or facilities used in local distribution, based on your explanation of these terms?

Mr. Wahrenbrock: I must object to that question on the grounds I have stated, Mr. Examiner.

Mr. Branch: Well, I think it is perfectly clear now.

Trial Examiner: I don't think that Mr. Hughes was the only witness that saw it. I would like to ask one question of the witness, whether he saw these facilities himself?

The Witness: I have not.

Mr. Branch: I don't think that that makes it invalid. [*2956*] Of course, Mr. Thomas couldn't have seen the facilities at East Hampton, as they existed as of the time that he saw them; at least it appeared that he didn't see them, yet he went ahead and testified. And Mr. Thomas, I think, also stated what I should suppose would be equally applicable, when I cross-examined him, as to various facilities that an engineer can get an idea of facilities from maps and diagrams, and so forth. Now, it appears that this witness has studied the exhibits which show these things. He has read the testimony of Mr. Colvin, the testimony of Mr. Thomas, and consequently he is in a position to express his opinion.

Trial Examiner: There seems to be so little question in regard to that. However, it seems to the Trial Examiner that the question of the doubt involved there goes to the weight and not to the admissibility of the testimony.

Mr. Branch: Mr. Examiner, the matter of the physical inspection of the facilities in the case of the Torrington facilities rests on entirely different grounds than those in the case of the East

Hampton facilities, because in the case of the Torrington facilities there is this problem created by the nature of Mr. Hughes's testimony, and if the witness read parts of that testimony, and has not personally viewed the facilities in order that he may have corrected any misapprehension he may have gained from partial reading of Mr. Hughes's testimony, then I submit no proper basis has been laid [*2957*] in the study shown to have been made by the witness for him to give the opinion which he is now called on to give.

Trial Examiner: I think that that goes to the weight and value of the opinion, and not to its admissibility. The witness will be permitted to answer.

By Mr. Branch: *Q* Will you answer the question, please? *A* I should classify all the facilities of the Connecticut Light and Power Company in this district as facilities for local distribution, except the facilities of the Robertsville plant, which I would call facilities for generation. Most of what I have said—

Q Will you explain? *A* Most of what I have said about Middletown is applicable here. The facts regarding voltage and distance, while they should be considered, are not determinative, for, as I have said before, the test is not a quantitative one. The principal point of difference is the stepped-up line, stepped-up in voltage, which runs to Winsted. The characteristics of this line differ from those usually associated with transmission facilities. Transmission lines are characteristically, though not always, carried on high steel towers, and are not found along city streets or highways, whereas the Torrington-Winsted line is carried on wooden poles, and for at least a part of the way along city streets and highways in the manner usually [*2958*] associated with lines for local distribution. Higher voltage that the Torrington system is employed merely for engineering reasons. Formerly it served several customers, as I understand, and in this it was clearly fulfilling a function of distribution. Reduction in the number of customers served does not justify a change of classification from distribution to transmission, where substantially the same contruc-

tion is used and the function and general characteristics remain the same. Taking a comprehensive view of the system, distribution began at Torrington, where the transmission of the Connecticut Power Company delivered power to the Torrington Electric Light Company.

* * * * * * [2959]

Cross Examination by Mr. WAHRENBROCK.

Q Professor Scott, what is the voltage of the generating plant at Robertsville? *A* I do not know.

Q Well, have you any notes or materials by which you can tell what that voltage is? *A* Not at hand. I could probably get it from the records in a moment.

Q Well, do you know what the voltage of the line which connects the generating plant with the Winsted substation is?

* * * * * *

The Witness: I have been subjected to so many figures with regard to voltages, and so on, at different parts of the line, that as a matter of memory, I do not have that.

[2960] By Mr. Wahrenbrock: *Q* Well, do you know what the voltage of the distribution system in Winsted is? *A* My best recollection there is that the voltage is reduced by the transformer to, I believe, 2300.

Q Well, is there a transformer in the line between Robertsville and the substation in Winsted?

* * * * * * [2961]

Mr. Branch: Well, this gentleman is a bit deaf, and the Examiner made a statement which I think he is entitled to hear, and I don't think he heard it.

Trial Examiner: Do you fully understand the situation now? Can you hear me? Mr. Scott, can you hear me?

The Witness: Yes, I think I heard everything, and if I may ask you, whether this is a question, a test of my memory and my

knowledge of it, or whether it is a method of getting the facts, and if it is a case of getting the facts, I would like to refresh my memory by looking at the diagrams.

Trial Examiner: If you wish to do that, you may.

Mr. Wahrenbrock: Mr. Examiner, I should like to test the witness's familiarity with the facts which are relevant and [*2962*] material to the conclusions which he has expressed, without reference to any diagrams or notes, please.

Trial Examiner: I think that has already been shown as far as this matter is concerned. The witness does not have a recollection in his own mind of it.

Mr. Wahrenbrock: May I see what the answer to the question about the transformer is?

Trial Examiner: Well, the witness says that he doesn't know without reference to the diagram.

Mr. Wahrenbrock: I don't believe that has been stated.

Trial Examiner: Is that not the case, Mr. Scott?

The Witness: Yes, sir. I consulted the diagrams, and have formed an opinion as to the general functions of the system, without taxing my memory with the particular voltages or the particular transformers involved.

Trial Examiner: I see. In other words, you could only state with the assistance of diagrams what the voltages were or what the transformers were?

The Witness: I do recall the diagram gives two banks of transformers, each of 1500 k.v. in the Winsted station.

Trial Examiner: But that is not between Winsted and Robertsville?

The Witness: And my best recollection is that the voltage line, that the line which comes up from Winsted is continued on to the other station. But I consider that as secondary to [*2963*] the general layout and general purposes of that system, and have not taxed my memory with it.

Trial Examiner: It is so understood.

Mr. Wahrenbrock: I think that will forward our examination without the necessity of referring to the diagrams.

By Mr. Wahrenbrock: *Q* I would like to ask whether I understood what you were saying to the Examiner, what you were saying to the Examiner with respect to the line from Torrrington to Winsted. Did I understand that you stated that that line, or an extension of that line, goes on to the Robertsville plant? *A* I said that I thought that was likely the case, though I am not certain.

[*2964*] *Q* At any rate, your recollection is that the voltage between Robertsville and Winsted is about the same order comparable to the voltage between Winsted and Torrington? *A* My general impression is Yes.

Q What is the neighborhood of the voltage between Torrington and Winsted? *A* 27,000.

Q Is that a one-circuit or a two-circuit line? *A* A two-circuit line.

Q Do you know how many customers are served from that line? *A* The diagram shows one customer served from one of the lines at an intermediate point.

Q Is any customer served between Torrington and Winsted from the other line? *A* The diagram that I examined did not show any connection from the other line.

Q I said "line" and you did too. I believe we both meant "circuit". *A* Very good.

Q I would like to turn to the Bristol situation briefly. I believe I understood from what you said that there was a 13,800 volt system to deliver electric energy to some industrial customers? *A* Correct.

[*2965*] *Q* And that there is a 4,600 volt system for distribution of energy to other customers? *A* Correct.

Q Now, leaving out of account for the moment the 13,800 volt system, forgetting that for the moment, and considering only the 4.6 k. v. system, if there were sufficient generating capacity operating at 4,600 volts in Hartford, what would be necessary, in

order to utilize that generating capacity to supply the load of the 4,600 volt system in Bristol?

* * * * * * [2967]

A An electric circuit connecting the two points which is designed as suitable for carrying the required power the specified distance.

By Mr. Wahrenbrock: *Q* Over such a distance, what would be the enonomical voltage to utilize in that circuit? *A* The distance I do not have in mind, except in a general impression. In general, however, a voltage of on the order of 1,000 volts per mile or somewhat higher would be in general satisfactory.

[2968] *Q* Assume that the distance is about 26 miles, what voltage would you say would be an efficient, economical voltage to utilize? *A* A voltage on the order of 30,000.

Q Now with a 4,600-volt generator and a 4,600-volt distribution system in Bristol, how would the 30,000 volt line or circuit that you have spoken of be fed, by what facilities? *A* Through raising and lowering transformers.

Q That is, there would be a step-up transformer at Hartford? *A* Correct.

Q That would step the voltage up from 4,600 to 30,000 at Hartford? *A* Correct.

Q And there would be a step-down transformer at Bristol? *A* Correct.

Q And it would step the voltage down from 30,000 to 4,600 again? *A* Correct.

Q And would you call that a transmission circuit?

Mr. Branch: Well, I think "that" is rather vague. It ought to be specified what he means, and I object to that.

Trial Examiner: I think counsel may well make himself a little more clear.

[2969] Mr. Wahrenbrock: Well, I understood the witness to say that in order to make the generating capacity at Hartford

available for distribution of electric energy in Bristol, it would be necessary to provide a circuit.

The Witness: That is correct.

[*2970*] *Q* And would you call that circuit a transmission circuit? *A* If it is coming from a power source in Hartford, and delivering to Bristol, according to the definitions that I have given, I should say that it was.

* * * * * *

Q I just wanted to make sure I understand that with the generating capacity at a voltage of 4,600 volts available in Hartford and a 4,600 volt distribution system in Bristol, to be supplied from Hartford, it would be necessary to add a trans- [*2971*] mission circuit consisting of the step-up transformer, the transmission line, and the step-down transformer. Am I right in that understanding? *A* That would be the normal and usual method by which engineers would meet that situation, yes.

Q And the step-up transformer, the transmission line, and the step-down transformer are the facilities which would have to be supplied in order to accomplish that purpose? *A* That is correct.

Q Could the purpose have been accomplished in any other way? *A* The transformer could be omitted and the line run at 4600 volts, but the amount of copper required in proportion to the energy delivered would be excessive, and that would ordinarily not be the economical way of making the transmission.

Q I wish to return to the Winsted to Torrington line, or the Torrington line to Winsted line, and I believe that you said something about the location of that line. In order that I may be sure that I am correct, will you state whether you said that that line was located along the highway or on the highway? *A* I said that during a part of the line it ran along the streets of Torrington, and I do not recall that I definitely stated the character of the line across country, whether that was on private right of way or highway. My impression is it was the highway.

[2972] *Q* Would you like to refer to the manuscript from which you read your direct testimony? *A* Yes.

Mr. Wahrenbrock: May the record show the witness is so referring?

Trial Examiner: The record will show that.

The Witness: Reading from the testimony I gave a little while ago: The Torrington-Winsted line is carried on wooden poles, and for at least part of the way along city streets and highways in the manner usually associated with lines for local distribution. I think that covers the point.

By Mr. Wahrenbrock: *Q* Yes. Now, do I understand the force of what you there said to be that you based your conclusion as to the function served by the line between Torrington and Winsted on several factors, including among others, the location of the line as you have stated, and the fact that it was a wooden pole construction?

* * * * * *

The Witness: In general, that is correct. I gave the general conclusion that the services from the Torrington [2973] station should be considered as distribution on account of the function they performed, of getting the power which was received at wholesale from the Connecticut Power line, which was delivered to the Torrington station, for delivery in that general district, partly in Torrington and partly in Winsted and vicinity, and that looking at the system as a whole, from generation to utilization the circuits and service from Torrington station were in the nature of distribution, and laid out in the best way to get the electric service to the various customers. And then I incidentally mentioned that the type of construction which was used in the line from Torrington to Winsted was different from the construction of the transmission line which served Torrington, and was of the form of construction, which was common to distributing systems.

Q Yes. Well, do I understand then that you looked at the entire region centering around Torrington, and considered the

nature of facilities radiating out from Torrington, and among those facilities you considered the line which leads to Winsted, and you took into account the location of that line along highways, and its wooden pole construction, in coming to your conclusion that you stated on direct examination? *A* That is correct. And in that whole system of receiving power from another place, there was one element up to the Torrington station which was considered as transmission, and its voltage and construction, and so forth and so on, were [*2974*] appropriate to the delivery of power in large quantity, whereas the circuit from Torrington to Winsted was of a different character, adapted for lower voltage, and with the construction ordinarily used in lower voltage service.

[*2975*] *Q* Well now, suppose that the Torrington Electric Light Company, instead of obtaining its supply of electric energy from the 66 k. v. lines of the Connecticut Power Company, obtained all of the electric energy which it received and which it sold to The Connecticut Light and Power Company by its own generating capacity in Torrington, would that affect your conclusion as to the function performed by the Torrington-to-Winsted line? *A* Under the conditions you have just cited, we have a system in which the power source is at Torrington and, as I have pointed out in my testimony, the matter of transmission and distribution are relative terms, and you have now a smaller system to consider and the line to Winsted taken directly from the power source to a point of distribution might be considered as a transmission line. All that shows that the transmission and distribution are not matters of particular voltage or what not, but in my view the whole system in each case from the power production to the ultimate consumer must be considered.

Q About this location of the Torrington-to-Winsted line, how long is that line? *A* Ten miles, or a little more.

Q And how much of that ten miles would you say is located on City streets or the highways? *A* My recollection from the map is that it is something [*2976*] less than a mile.

Q And it is your recollection that the remaining nine miles of the line are located where? *A* They are shown on the diagram as straight lines, presumably along the highway.

Q On the highway right-of-way or on a privately-owned right-of-way? *A* It would be simply assumption on my part. I do not know the facts—along the public highway.

Q Well, I would like to be corrected, if I misunderstood what you said a little bit ago, that in considering the nature of all of the facilities in the region radiating out from Torrington, and particularly considering the nature of this one line radiating out from Torrington, you took into account its location along City streets and highways, and this woodpole construction, and so forth, am I right in my recollection? *A* I take it that you are, and in considering the system as a whole, with a 66,000 volt line delivering wholesale power to Torrington, in that system this line from Torrington to Winsted was of a different character and did not class in that system as a transmission line.

Q And I understand too, that if, instead of being supplied from The Connecticut Power Company's lines, 66,000 volt line, the supply had been by a local generator in Torrington, that then the relative situation changes? [*2977*] *A* Then we are considering a different system.

Q Now, let me ask if this line from Torrington to Winsted were 27 miles long and if the greater part of that distance, except where it actually entered towns at each end, if the greater part of that distance the line led over privately-owned rights-of-way, not on or immediately adjacent to the highway, if that would affect your conclusion any? *A* That conclusion being that if the line from Torrington is considered as a part of the general system in which it is aiding in distributing the wholesale power received at Torrington, it would be considered as a part of the distribution system. Second, that if there is no transmission to Torrington, but Torrington has its own generators and the line then becomes a part of a different system, it might be properly considered as a

transmission line. Your present question, if I can have one second—

Q I was leaving that question to one side, which I thought was disposed of by the previous answers, and seeking to put a separate question now, and that is: With the supply of energy from The Connecticut Power Company's 66 k. v. line as it is at present, but with the line from Torrington to Winsted being 27 miles long, and instead of going along on the highway, going on a privately-owned right-of-way for the greater part of the distance, if that would affect your conclusion?

* * * * * * [2978]

A I think the conditions as I recited them in my preliminary answer a moment ago still apply. If we are considering that as a part of the whole system and a part of the distribution of the wholesale power received at Torrington, we can consider it as a part of the distribution system, if it be from power generated in Torrington as a part of the transmission system. We are here encountering the difficulty of applying certain general terms to a lot of specific and complicated conditions, and, as I said in my direct testimony, we are apt to get into dilemmas because sometimes the same element in the system may be performing two functions or the same physical element sometimes one function as a part of one system and at another time another function as a part of a different system.

* * * * * * [2979]

Q Professor Scott, is there any difference between what the Torrington-Winsted line does when the 66 k.v. line of the Connecticut Power is the source of supply of electric energy, and what it does or what it would do if a generator at Torrington was the source of supply of electric energy? *A* It would be substantially the same. In my direct testimony I said the performance of a particular section of a system, as to whether that is transmission or distribution, may be determined by what follows, or by what precedes, transmission and distribution being relative terms. And

here, what precedes in one case is simply a powerhouse, when the generators are in Torrington, and we can consider it as a transmission line. If it is, however, a part of the general system in which there is transmission ahead of it, then with respect to its place in that large system, I would consider it as distribution. That may be somewhat fanciful, but it is the difficulty in applying certain general terms to specific cases.

Q But actually, as far as the line itself is concerned, there is no difference in what it does? *A* Correct.

Q I believe you have stated that the synchronous condenser at Bristol serves two functions, one of which was to maintain a constant voltage for the distribution circuits [*2980*] there. Does the synchronous condenser cause the distribution voltage to remain constant, when presumably there is a tendency for it to vary, by altering the conditions of current flow in the distribution itself, or by varying them in the transformers and the transmission lines? *A* May I have the question read?

* * * * * *

The Witness: An alternating current machine has a field excitation and produces electromotive force. It does this whether the machine is used as a generator in the powerhouse or as a synchronous motor delivering power to customers—or as a synchronous condenser which runs idle, as far as the delivery of power is concerned. Now, when this machine is used in the Bristol powerhouse, the voltage produced by the machine is controlled by its field current. This therefore is a simple means of producing the desired voltage, and holding it at the desired value in the Bristol substation. The operation of the machine leads to readjustment or equalization through the power system back to the generator. A part of the electromotive force which might be produced in the generating station, for example, by the placing of this synchronous condenser there, is on the other hand, pro- [*2981*] duced at the Bristol station where the voltage is required to be held at constant value, and there is internally within the system the proper

interchange of current which enables one machine operating at Bristol to work in parallel with the machines at the generating station. On the other hand, the current and service on the local services are the same whether the station voltage is determined by the local synchronous converter—synchronous condenser, I mean, or whether that voltage were attained by changing the transformer ratio, or by readjustment of voltage at the power station. In brief, therefore, the method of maintaining voltage by the synchronous condenser does not directly affect the distribution circuits to customers, but that is the same that it would be if the voltage were secured by some other means. There is a flow of current adjusting the synchronous condenser in the substation to the generators which supply the system.

Q In connection with your testimony about East Hampton, I made a note of one point that after referring to the voltage by which Middletown is supplied, you spoke of two subsequent voltages. Did I understand that you meant that before the circuits reached Pole 110 there had been two step-down stages? *A* No. I intended there to indicate that the voltage in Middletown was lowered to two values, one, the 13,000 volts, if I recall, which goes over to Portland, and beyond; and the other a lower voltage for local distribution in and about [*2982*] Middletown.

Q Well then, that lower voltage has nothing to do with the circuit that goes over to Pole 110? *A* Correct.

Q With that in mind, do you have the distances in mind from Pole 110 to the—I will have to refer to the diagram in order to complete my question. Do you have in mind the distance from Pole 110 to the West High Street substation? *A* As I recall, that is the first substation east, and by a comparison of the scale on the map it is between four and five miles. I think approximately four miles in a straight line, and there is a little wiggle to it that would add something to that.

Q Now, is it your understanding that any customers are served from that line between Pole 110 and the West High Street substation? *A* I think there are none.

Q And is it your understanding that there are any customers served between the West High Street substation and the Leesville substation? *A* I believe there are none.

Q Are there any customers served from the line between the West High Street substation and the Comstock Bridge substation? [*2983*] *A* I do not recall any indication of that.

Q And between that substation and the Westchester substation? *A* The same.

Q And between the Westchester substation and the Colchester substation? *A* The same answer.

Q Then do I understand that at each of those substations there are step-down transformers? *A* So I understand.

Q And from the secondaries of those step-down transformers there are radiating lines at lower voltages from which customers are served? *A* So I understand.

Q In one of your earlier statements on direct examination, I believe that you referred to transmission as being the conveying of large units of power over considerable distances at high voltage to localities where it was to be utilized. Am I substantially correct in that recollection? *A* You are.

Q What did you have in mind by "localities"? What is the conception of "localities" which you had in mind, which you have in mind, when you make that statement? *A* A place or a district where the power is to be used.

Q Well, how large? What bounds the district? What [*2984*] bounds the locality? *A* The location of the customers to be served, if you choose. I have indicated that a distribution system might properly be applied to a few city blocks in one case, or a small city in another, or rural electrifications where many miles are to be covered, to reach farms and small hamlets.

Q Taking the first instance, where the locality would consist of a few blocks, under what circumstances would that be true? *A* I think I gave an illustration there that in service in a city a 2,300 volt line from the station might supply several City blocks, in which transformers reduced the voltage to say 220 volts and

that was distributed from that transformer through a few thousand feet covering some city blocks, a few city blocks.

* * * * * * [2985]

Q The 2300 volt lines radiating out would cover the locality, and with their sub-lines, they would supply all of the customers in that locality that you had in mind. *A* I think my idea was a little different from that. I wish to show that the matter of distribution didn't depend on voltage or exact area, but was a function to be performed. If for a few city blocks we have one transformer which supplies the customers in that block by radiating lines from it, that might be considered as the distribution area of those city blocks, and the link in the system, the 2300 volt circuit from the local station to it, is relative to it, a transmission supplying that few blocks as the distribution area. From another viewpoint, the city station itself with its radiating 2300 volt lines may be considered as a larger area of distribution from the city station, which in turn may receive the current from a different point, in which the line to the station is transmission, and the whole city is the distribution area. Again, the supply to that city may be a part of the system in which from a source, current is supplied at maybe 13,000 volts to a number of areas, towns, or small cities, and in that case the relationship would be distribution at 13,000 volts [2986] from a point where power was received in larger bulk. Transmission and distribution then being relative terms, and if you take any two adjacent elements, links in the system, one link may serve as transmission to what is beyond, and it may serve as distribution when compared with the links back toward the generator. The whole thing is artificial in a way, and relative, and so that the best answer I have been able to give to the whole situation is that it is a relative situation, and not an absolute one, depending on the particular conditions, and one particular line may serve, looked at one way, as transmission, and looked at another way, as distribution, and you can imagine cir-

cumstances in which it may be seeming to perform both functions at once.

Q Well, then, you could look at the matter more largely, look at a State the size of the State of Connecticut, and say that even on a larger scale there was distribution over the whole State, could you? *A* If in the whole State the power were received from the original source or sources of power, at a high voltage, and the power was delivered at certain places in wholesale form, in large amounts, which are then taken locally and distributed to customers, why, yes.

Q Well, in the same way then, if a huge giant power or super power gridwork, covering the whole United States, [*2987*] were constructed to supply all the communities in the United States, you could say that that system distributed the electric energy on it throughout the United States in the same way? *A* And you are leading up to the fact that in general the whole electrical system, large as it may be, the United States if you choose, involves many links, and all of those are actually transmitting power, and the whole system is for the purpose of distributing power from the sources to the different consumers, and we come in in a sort of an arbitrary way here, to divide any system or any part of it, into the two functions of transmission and distribution. That has come about from the presentation of the subject. I was asked what is transmission and what is distribution. How are they related? And it is a relationship rather than absolute values.

* * * * * * [*3024*]

PERCY H. THOMAS,

a witness previously sworn, is called in suf-rebuttal on behalf of the Federal Power Commission, and testified as follows:

Direct Examination.

* * * * * * [*3025*]

Q Will you explain the relation of current and energy in the

operation of an electric utility system such as The Connecticut Light and Power Company?

* * * * * *

A The energy in an electric circuit is measured by the instantaneous product of the current and the voltage. As a matter of practical operation, it is found necessary to maintain constant voltage or e. m. f. on lines so that appliances may operate properly. It is generally appreciated that even very slight changes in voltage in a filament lamp greatly affects its efficiency and life. From this it follows that in circuits that current becomes a measure of the energy. Changes in [*3026*] energy are reflected in changes in current, and changes in current are reflected in changes in energy.

I will add that if effective values of current and e.m.f. are involved, instead of instantaneous values the product of the current and the voltage must be multiplied by the power factor to obtain the energy.

* * * * * * [*3029*]

Q Then I will ask whether in your opinion, Dr. Slepian, in his testimony that the tracing of energy flows cannot be verified by physically observed facts, has taken into account all available facts which should be taken into account in order to determine the sources of supplying particular loads where various flows are supplied by various generators through a system of transmission circuits, and ask you if you can answer that with a yes or no answer?

* * * * * *

The Witness: No, he has not.

* * * * * * [*3030*]

Q In your opinion, has Dr. Slepian taken into account facts which a practical engineer does take into account in the design or operation of utility systems?

* * * * * *

The Witness: No.

* * * * * * [*3031*]

Q Will you explain? *A* Dr. Slepian has stated that no facts are observable except the existence of generation measurable by a watt-meter and consumption in appliances, also measurable by watt-meters.

I would point out that Dr. Slepian is ignoring much of what might be called circumstantial evidence, often entirely sufficient to determine energy sources in particular cases.

Q Will you explain what other facts should be taken into account? *A* Except possibly for Dr. Slepian, there is a general agreement here that current supplied to a single load over a single circuit, from a single generator, is known to come from that generator. But when several loads and several generators are connected by transmission circuits, the condition is more complicated, and the source of the individual load current is not so easily determined. Consider the designer of such a system. He knows that each load, say loads located at points A, B and C, for example, must be supplied with two sorts of current. First, work current, [*3032*] sometimes called active or in phase and, second, exciting current, sometimes called out of phase, reactive, or magnetizing current. And he further knows that these currents must be supplied by three generators, say at D, E. and F respectively. The designer then makes up his mind which is the best source for each of these load currents, and tentatively lays out circuits from each of the loads to each of the generators, a circuit for each of his currents. For sake of simplicity, assume currents to load A to be supplied from generator D; currents to load B from generator E; and currents to load C, from generator F. So far, the sources of each such load current—the source of each such load current is not disputed unless it be considered that Dr. Slepian dissents. The designer now examines the situation and finds that some of these circuits can be combined with economy, and in fact that for a por-

tion of the transmission distance, all circuits lie along the same route, and all may be inter-combined into a single transmission line. In that portion of the circuit where before combining, all currents flow side by side, some will be found to flow in one direction and some in the other, and further, some are by hypotheses out of phase. Now, when the several currents flowing side by side are combined into a single current, it will be found that this resultant net, actual, or total current, as it is variously called, [3033] will be much less than the arithmetical sum of all the separate load currents. I will point out that all these terms refer to the same current. According to Dr. Lewis and Dr. Slepian, this resultant is the only current that can be verified by physically observable facts in a transmission line.

Now, it is obvious, as Dr. Slepian has stated, that by merely looking at this resultant current in the transmission circuit, and ignoring all other information, it would not be possible, by the mere examination of this physical transmission line current, to tell where all the component currents come from. I don't think that the contrary has been contended.

What Dr. Slepian has ignored is the evidence of those portions of the system in which the component currents are not all in a common circuit. In many systems, perhaps not all, it is found possible, by the use of this additional or circumstantial evidence, to determine the sources of current even in rather complex systems. There may be some system in which such circumstantial evidence is not sufficient. A trial must be made in each case.

* * * * * * [3037]

Q Will you identify for us the facts which are overlooked, in your opinion, by Dr. Slepian's testimony, or in Dr. Slepian's testimony? *A* I have in mind the fact that by watt-meters and otherwise, it is possible to determine the magnitude and directional flow of many of the component currents which make up the transmission line current, where these currents are flowing in separate

circuits. So that there is no confusion of one by its being mixed with another.

Q Now, can you show what the nature of those facts are in relation to the type of flows that we have under consideration in this case? *A* I can take a case in which energy is flowing over the Agawam lines toward South Meadow substation. In the interest of clearness, I will treat the current as though it progressed slowly from Massachusetts to Connecticut, although it is known that this transfer is practically instantaneous. A slug of current on this line, the amount of which is known from the readings of instruments, reaches the South Meadow outdoor substation, and finally gets into the 66 k.v. bus. There it must follow the bus until some tap is reached. The first tap is at the feeder known as 122, which connects with the 11 k.v. Hartford bus. Meters show that the current in [*3038*] this feeder is flowing toward the 11 k.v. bus from the 66 k.v. bus. I assume, tentatively, that the current in the 122 tap comes from the slug of Massachusetts current. Therefore, I assume tentatively that the balance of the slug follows the 66 k.v. bus further until it reaches the next tap which is feeder 123, similar to feeder 122. Here another portion of the slug is assigned tentatively to feeder 123, because the instruments show that current is flowing in 123 towards the 11 k. v. bus. This leaves a diminished slug of Massachusetts current following the 66 k.v. bus to the next tap, which is a double tap feeding the C.P. 1 and 2 lines. The instruments show that current is flowing out on the C.P. 1 and 2 lines, and I tentatively assign an amount of the remaining slug of Massachusetts current to the C.P. 1 and 2 lines. The residue flows on further in the 66 k.v. bus. The next tap is feeder 124, leading to the 11 k. v. bus, and as this is the only remaining outlet from the 66 k. v. bus, I examine the instruments in feeder 124, and since these indicate that the flow of current is toward the 11 k. v. bus, and is in an amount equal to this residue, I conclude that my tentative assumption as to the flow of current into the various taps is proved correct, and that the source of the current in the C.P. 1 and 2 lines is the Agawam lines.

[3039] I want to emphasize that in tracing this current flow, no reliance has been placed on tagging or identifying units of current by any observation of its characteristics in the place of delivery. In tracing the flow of energy in the C.P. 1 and 2 lines to Massachusetts—I beg your pardon—the Agawam—in the interest of clearness, I have made use of current in place of energy. The same process may be used for energy. The opportunity to use the circumstantial evidence lies open to both.

I would like further to state, in justification of this use of current for tracing flows in systems, that the energy in an electric circuit is measured by the instantaneous product of the current and the voltage. As a matter of practical operation, it is found necessary to maintain constant voltage or e.m.f. on lines so that appliances may operate properly. It is generally appreciated that even very slight changes in voltage in a filament lamp greatly affects its efficiency and life. From this it follows in such circuits that the current becomes a measure of the energy. Changes in energy are reflected in changes in current, and changes in current are reflected in changes in energy.

I will add finally that if effective values of current and e.m.f. are involved, instead of instantaneous values, that the product of the current and the voltage must be multiplied [3040] by the power factor to get the energy.

* * * * * * [3041]

Q In what respect has Dr. Slepian failed to take into account these facts to which you have referred and which, in your opinion, should be taken into account?

Trial Examiner: It doesn't seem to me that your question is clear. Do you mean again what facts he has left out?

Mr. Wahrenbrock: No, I wish to ask the witness to explain.

Trial Examiner: All right. Do you wish to ask the witness to explain what was in Dr. Slepian's mind? If so, it is not proper.

Mr. Wahrenbrock: No, I am asking the witness to explain in

what respect Dr. Slepian's testimony shows that he has omitted to take these facts into account.

Trial Examiner: In other words, what you want to know is what, in Dr. Slepian's testimony, shows that he has omitted the consideration of these facts?

Mr. Wahrenbrock: Yes.

Trial Examiner: The witness can point out that part of the testimony showing the omission. With that understanding, he may answer the question.

[*3042*] *A* When he undertakes to say that no knowledge in these circuits can be had by verifiable observation except as to the total of generation and the total of consumption in a system.

* * * * * *

Q Do I understand then that you are of the opinion that Dr. Slepian has ignored the evidence provided by the separate circuits connecting with the C.P. 1 and the C.P. 2 lines?

* * * * * *

A Yes, that is my view.

* * * * * * * [*3043*]

Q Have you considered Dr. Slepian's views as to the relation of component currents and resultant actual current in the transmission line as stated by him in his testimony? *A* Yes.

Q Do you find his conclusions in that matter with respect to component currents and the resultant actual current susceptible to misconstruction or erroneous application?

* * * * * *

A I have spoken of the system designer as planning his system and seeking out all the separate sorts of current from all the loads that he must provide for, and then when his investigation is complete, combining such as might to his advantage be carried in a single circuit. He passes from the known [*3044*] components to a resultant current.

On the other hand, Dr. Slepian and Dr. Lewis as well must consider the resultant flow existing in an actual completed transmission line when they have occasion to resolve it into components for some purpose or other, possibly to determine from what original component currents the resultant was formed. There is no material difference in the two points of view. Thus is seen one purpose for which this method of flow postulates might be used. Dr. Slepian's and Dr. Lewis's statement are, in effect, that you can set up any fictitious assumption as to what components might have been combined to make the actual flow in the common conductors, and consider it as reasonable as any other, subject only to his criterion of total loads equalling total generation.

* * * * * *

A (Continuing) The critical point made is that whatever set of allocations of load the allocator sets up, that Dr. Slepian carefully states that when the allocator is interested in the physical flow in the transmission line itself, [*3045*] he must not use the fictitious flow components, but must use the total net actual current, to avoid error.

This is in agreement with the statements of my own prior testimony, and with the practice of engineers, but Dr. Slepian's and Dr. Lewis's cautions mean further that these currents into which the net current may be constructively divided and which they say may appear to flow in opposite directions in the circuit at the same time are not the actual physical currents, but merely artificial fictions which they may have found useful for some purpose. Obviously only the actual current can be depended upon to trace electric energy to its actual source, no fictitious components would establish actual counterflow.

* * * * * * [*3046*]

Q In his testimony, Dr. Slepian referred to the phenomenon that when an alternating current flows in a conductor of material dimensions, the current in the center portion lags behind the rest of the current, and that at the time when the current is reversing

in direction, it may still be flowing in the original direction after the balance of the current is reversed, and he has suggested that this may illustrate simultaneous counterflow. In your opinion, does that phenomenon illustrate simultaneous counterflow?

Mr. Branch: I object. I don't think that that is quite an accurate statement of the testimony. Anyway, I would like to have the testimony read on that point, rather than an attempt to paraphrase it.

Mr. Wahrenbrock: Mr. Examiner, I don't think that anyone who reads this testimony is going to rely upon my paraphrasing of Dr. Slepian's testimony, instead of reading the original.

Trial Examiner: Well, I think in view of the fact—

[3047] Mr. Wahrenbrock: I have merely referred to it, I haven't said that was the testimony. I said it was testimony about that.

Trial Examiner: The witness may answer the question. It is Commission counsel's own risk if the question doesn't fit the facts.

Mr. Branch: I object on the grounds I stated.

Trial Examiner: The objection will be noted.

A If Dr. Slepian has considered that this phenomenon is simultaneous counterflow in a conductor in the sense that I have used that term, he is mistaken. He has picked out a well-known characteristic of the flow of alternating current in a conductor of large diameter, found with all flow of alternating current in such conductors and not concerned particularly with the particular flow condition where two generators at the opposite ends of a conductor are trying to cause oppositely directed flow at the same time at the same point in the conductor. Dr. Slepian's lag in the center current flow is an aspect of what is called skin effect in electric conductors. Except for conductors of very large dimensions, it is of no importance. Skin effect receives attention, when it does receive any attention at all, on account of a certain increase in apparent resistence of a conductor that may be observed. In the conductors of the C.P. 1 and C.P. 2 lines, this increase of resistence would be less than about one-tenth of one per cent [3048] in magnitude, but I will repeat, that this mere slight lag of flow

in the center of the conductor behind the rest, has no significance since, broadly speaking, it involves a circuit taken as a whole, merely passing current from a single source to a single load and is not related to counterflow.

My statement as to no simultaneous counterflow was to the effect that when two sources of e.m.f. endeavor to pass current in opposite directions through the same conductor at the same point simultaneously, the result will be an actual resultant current caused by the predominating e.m.f. which will be the resultant of the two currents that would occur were the two sources acting separately in time. This is in accord with the conception of the physical phenomenon of current flow stated by both Dr. Slepian and Dr. Lewis, which regards electric current as the resultant or net movement in one direction, resulting from the heterogeneous motions of free electrons in the conductor.

Obviously there can be only one such resultant or net flow. This is the actual or physically verifiable current. It necessarily follows that there cannot be a simultaneous counterflow of current, because the net flow cannot be in both directions at the same time, and at the same place.

This conclusion has an important bearing on the significance to be attached to the illustrations of counterflow, so-called, by Dr. Slepian and Dr. Lewis, conceived of as occur- [*3049*] ring as a result of opposed components of a resultant current. These include, for example, such groups of components as active and reactive current in a power circuit, exciting and load current in a transformer, and positive phase, negative phase and zero phase potentials in an unbalanced three-phase current.

Naturally, in studying efficiency and capacity and other relations in a power system, in which the engineer has information primarily with regard to the currents and energy in the main portion of the system and very little as to the details of individual consumers, he has occasion, at times, to seek out the effects of some particular aspects of the main currents.

For example, to determine the capacity for synchronous con-

densers, he would desire to know something of the reactive component of the main current. He is of course at liberty to ascertain what total current strength is involved in the reactive component, and he can imagine it to be real if he wants to. As a matter of fact when found in the winding of a synchronous generator or a synchronous condenser away from the transmission line it would be real. However, what he must recognize is that when his reactive component is combined in the transmission line with the load component, the reactive component has entirely lost its identity and that the flow of actual or net current in the line conductors as described by Dr. Slepian and Dr. Lewis, is merely the net drift in one [*3050*] direction of the free electrons. No trace of distinction between active and reactive components remains.

* * * * * * [*3051*]

Q I wish to ask you whether you were present during all of Dr. Slepian and Dr. Lewis's testimony in this case? *A* Yes.

Q And did you hear all of that testimony? *A* Yes.

Q In your opinion, does Exhibit 81-A, which I have shown you, and Dr. Slepian's testimony with respect thereto, show the unreliability of watt-meters if properly used? *A* No.

Q Will you explain your answer? *A* The sketch, Exhibit 81-A shows an obviously improper [*3052*] watt-meter connection, so that the only explanation of the discrepancy he has found that is required is the statement that no watt-meter improperly connected can be expected to show the energy under study. In an electric circuit, or a part of an electric circuit concerning which a knowledge of the quantity of energy flowing is required, the rule for the connections of the watt-meter may be stated that the current flowing into the circuit to be studied shall flow through the current coil of the watt-meter, and the voltage impressed upon that part of the circuit involved in the study in which the watt-meter current is flowing, shall be impressed upon the potential coil of the watt-meter, in order that it shall indicate the appropriate energy flow.

Now, in Exhibit 81-A, the only load is the ohmic resistance, and its amount is 100 watts. The current in the resistance is one ampere flowing in a path through the resistance, through the portion of the transformer winding between the top of the winding and the adjacent terminal, and back to the resistance. The voltage that makes this current flow is that impressed by this top section of the transformer winding, and is 100 volts. All this is as set forth in the diagram and Dr. Slepian's testimony.

If now the current coil of the watt-meter carries this one ampere, and the 100 volts of the circuit of the resistance is impressed on the voltage coil, the watt-meter will indicate [*3053*] 100 watts, which is the true value. Dr. Slepian agreed to this on cross-examination.

As he further testified on cross-examination, Dr. Slepian connected the full transformer voltage of 10,000 volts on the watt-meter potential coil, in making his test, this being 100 times the voltage causing the one ampere to flow. Naturally, the watt-meter reading was 100 times too much. The upshot of this explanation is that the watt-meter gave a ridiculous reading because the method of connecting it in the circuit was ridiculous.

In correction of his defending statement to the effect that he intended to make an overall measurement of the input to the transformer as a whole, with the watt-meter current coil carrying the current in the terminal, and the potential coil impressed with the total e.m.f. of the transformer, I will call his attention to the fact that his connection of the watt-meter does not take into account the third lead, the 9900 volt tap, which is an essential part of this system. The recognition of the effect of the current in this third lead would exactly correct the discrepancy which Dr. Slepian found.

Q In your opinion, is the conception of current flow as stated by Dr. Slepian and Dr. Lewis, in their testimony, inconsistent with the conclusions they have stated as to the mixing of electric currents in a conductor? [*3054*] *A* It seems to me that what Dr. Slepian and what Dr. Lewis have said as to the physical nature

of current flow in a conductor makes inevitable the mixing and commingling of energy in a conductor, as I have already explained. They picture an electric current as consisting of the motion of free electrons in a conductor in a given direction, the electrons as a whole moving in all directions, more or less indiscriminately under the effect of electric forces. These electrons are smaller than atoms and exist in vast numbers. The velocity of their motions is enormous. Considering the movement of these myriad of small bodies, it is obvious as they drift along they must soon be completely mixed and commingled in the wire, especially as in traversing only a few feet of conductor, hundreds of millions of atomic distances are passed. Under the law of probability, the enormous numbers of these high velocity electrons must point to a substantially perfect mixture of all electrons, regardless of any special segregation existing at the point of origin.

Q I call your attention to the testimony of Dr. Lewis relating to certain formulas involving "mutual" inductance of the magnetism, and what he called mutual resistance. In your opinion, does his discussion substantiate his hypothesis that with oppositely directed component currents, the resistance losses cannot be properly calculated as though the components were actual currents?

[*3055*] *A* The discussion both of the magnetic and resistance quantities that he treats relate to the interactions of two currents, tending to flow in opposite directions in the same conductor, in the one case, currents causing magnetic fields, and in the other, currents causing resistance losses. The net result of his mathematical explorations is to show that in order to obtain correct results, magnetism and heating effects respectively, in the conductor, when combining two oppositely directed currents in a single conductor, it is necessary to utilize only the resultant current which is the only physically existing or actual current.

Q There has been testimony in this case as to the electric field and to the magnetic field in the space around conductors, and the movement of energy therein. What in your opinion is the

significance of those fields? *A* The flow of energy in electric circuits is accompanied by e.m.f., or voltage, and current flow. The current is restrained within the conductor by the insulating qualities of the space, or solid material about the conductor. Now, the presence of the electromotive force in the circuit puts a strain, a physical stress on the space about, since this space must resist the electromotive force. This stress—

* * * * * * [*3056*]

The Witness: This stress is naturally accompanied by storage of electric energy in the strained material since the material is elastic. Similarly the current puts a stress on all surrounding materials, tending to magnetize them, and this is accompanied by the storage of magnetic energy in the surrounding space which is elastic to magnetic stress as well as to electric. As the e.m.f. and current are alternating, these stresses are alternating and the energy flows in and out. These actions have little or no relevancy to the flow of energy in the power circuits of electric utilities when the practical trans- [*3057*] mission of electrical energy is in question.

By Mr. Wahrenbrock: *Q* Referring to the testimony of Dr. Slepian with respect to the permissibility, in the case of two circuits entirely separate, as far as metallic connection is concerned, each having a generator and a load, and under his postulate of allocating load to generation in electric circuits, will you state whether, in your opinion, his position is of practical value in the understanding of the actual operation of electric utility systems?

* * * * * *

Mr. Branch: I object. I don't think that that is rebuttal of anything. I don't think that Dr. Slepian said it was. He was asked about a hypothetical question in cross-examination, and I think he made it very clear that he wasn't basing anything on those hypothetical questions which were asked of him on cross examination. As soon as the question was asked, he made [*3058*] it apparent what he was going to get at. He said, "Now you are

talking about a question in the actual world." He didn't base anything on that, and any question here based on the assumption it did, seems to me is irrrelevant.

Trial Examiner: It may be relevant, and I think that the trial examiner is able to determine whether it has any material value. The witness may answer the question.

Mr. Branch: May my objection be noted?

Trial Examiner: The objection will be noted.

* * * * * *

A In my opinion, it is not.

* * * * * * [*3060*]

Q Since June 17th, 1914, have you examined the facilities indicated on Exhibit 80-A which I will show you? *A* Yes.

Q When? *A* On July 24th, 1941.

Q Had you previously examined them? *A* Yes.

Q When was that? *A* During the last week of May, 1941.

Q During the interim, had any of the facilities been removed, or physically changed? *A* From a casual examination I did not find that any part of the facilities had been removed or altered, and I found no switch terminals or leads disconnected.

Q Had any additional facilities been installed in that interim period? *A* Yes.

Q Will you describe briefly those additional facilities and state whether they appeared to be of a permanent or temporary nature? *A* I noticed that a three-wire, 2.4 k. v. circuit had been installed in the outdoor substation, extending from a point which is found at the outer ends of the three current coils in The Connecticut Light and Power Company's circuit [*3061*] leading from the Winsted line transformer to the pothead leads of one of the two three-phase groups of main cables connecting the 2.4 k. v. outdoor bus to the main indoor 2.4 k. v. bus. This three-wire circuit includes a set of three additional oil circuit-breakers, mounted on a temporary wooden base. The three 2.4 k. v. cables and their connections to the circuit were obviously of a temporary nature.

Q Did you notice any differences in the modes of operation of facilities at Torrington in your two examinations? *A* Yes.

Q What were those differences? *A* The system seemed to be in the state that it was during my first visit, except that the added facilities permitted the supply of current directly from the Torrington steam plant to the Winsted transformers of The Connecticut Light and Power Company, without the use of the substation equipment. The Winsted load was being so carried by this steam plant when I was there.

Q Was there anything about the installation of the additional temporary facilities to prevent renewal of the former mode of operation on short notice? *A* No. There was no condition to prevent operation of the facilities in the same manner that they were being operated on my first visit, should the staff so wish to do.

[*3062*] *Q* In your opinion as an engineer, has the character of the facilities by which electric energy was formerly supplied to Winsted from The Connecticut Power Company's lines been changed by the additional facilities and changed mode of operations? *A* As I have stated, no physical change has appeared in the facilities that I observed in May, 1941, and they were still capable, in my last visit, of the same use as on the former; they obviously have not changed as to character.

* * * * * *

Cross-Examination by Mr. BRANCH.

Q Mr. Thomas, did you find on your recent visit, which I think you said was on July 24th, at Torrington, that there was an electrical connection between the C.P. lines and the facilities of The Connecticut Light and Power Company at Torrington? *A* If you mean that the disconnects and oil-breakers were closed, so that the actual conduction of current could occur, I would say "No."

Q The fact is that those were not closed, were they? *A* The switches and disconnects?

Q Yes. *A* No.

[3063] *Q* And you ascertained, did you not, that that was the present normal operating condition? *A* I was in no position to determine that question.

Q Do you mean to say you made no inquiries to find out whether it just happened at the time you went up there that was so, or whether that was now the regular arrangement? *A* It was my impression, and I assume it is so, but I didn't make an investigation directly to justify an affirmative answer to your question.

Q You weren't interested in finding out what the normal situation was? *A* I tell you, my impression was that that was the normal situation. I didn't set myself to prove it.

Q But you say that you were satisfied that the normal method of operation at the present time, and the method which is followed, except in emergency, is for the Torrington steam station to be the sole source of supply to the facilities of The Connecticut Light and Power Company at Torrington and Winsted? *A* Well, with the exception of emergency connections, I expect they expected to get the very great majority of their current and power that way.

Q And you say "the very great majority." The only other source would be Robertsville, wouldn't it? Or was the equipment in the condition in which you saw it when you were [3064] there? *A* No, I stated that it is a question of closing switches to go back to the old operation, getting power from the C.P. Company.

Q But unless that were done, the entire supply would come from Torrington and the Torrington steam plant and the Robertsville plant? *A* As long as these switches connecting to the C.P. lines were open.

Q Yes. Now, Mr. Thomas, is it not true that there is often a large current flow of reactive volt amperes in one direction simultaneous with an energy flow in the other direction, in conductors? *A* I think I have made my position pretty clear on that. Have you some new point in view in asking that question?

Q I wish you would answer my questions, instead of trying to probe my mind.

* * * * * *

A I will say No, but it may answer the intent of your [*3065*] inquiry if I point out that it may be that true power, active power, may be sent from one end of a line to the other, and reactive power sent from the second and to the first, and each reaches its destination, but the flow in the line between will be a resultant flow and not a double flow of energy. In making that statement I have to assume that this result is accomplished by the generator at the power end being able to short-circuit from the line to the load at its end, speaking in instantaneous values.

By Mr. Branch: *Q* Well, doesn't that situation obtain in the synchronous condenser, frequently?

Mr. Wahrenbrock: I don't understand the reference to that situation, Mr. Examiner.

Trial Examiner: I think it is a situation which has just been stated in the last answer of the witness. I think that may well be understood.

Mr. Branch: Yes, sir.

Mr. Wahrenbrock: Well, I don't identify a situation which has been stated.

Trial Examiner: The witness has stated a certain circumstance of flow under certain conditions.

The Witness: I have stated that synchronous condensers and generators can contribute to a system each its own type of energy, and the result is accomplished by a single line, [*3066*] but that that does not involve reactive energy and active energy passing in opposite directions over the line.

By Mr. Branch: *Q* When each supplied the other with what it does supply simultaneously? *A* I had in mind an instant of time, what you might call simultaneous operation.

Q Then the answer to my question is "Yes," isn't it? *A* It depends on what your question means. The difference hinges on

whether you recognize a resultant current as accomplishing these two results or whether you wish me to visualize two actual currents passing in opposite directions in the same line at the same time.

Q Well, isn't what you are talking about just a convention? *A* If you mean the considering that the active and reactive currents flow simultaneously in opposite directions, that would have to be a convention, it wouldn't be a fact.

Q How do you know that it is just one current? *A* Well, its heating effects would be one method of judging that. It is, I should say, obvious to an engineer that physically that is the only thing that could exist, according to any practical working theory we have, but the fact that the heating effect produced checks with the single current is one positive evidence.

[*3067*] *Q* Well then, do I understand that you do deny the possibility that reactive volt amperes may flow in one direction, while active energy flows in another direction in a conductor? *A* I deny that in my opinion two physically independent currents can flow or that currents of energy could so flow simultaneously in opposite directions in the same conductor.

Q Do you regard the flow of reactive volt amperes as a flow of current? *A* I have explained that under certain circumstances, as where we have a constant potential impressed upon a system, that it is convenient to picture the flow of current which is more easily pictured and recognized and that we are able to infer for many purposes the result that we would get if we were using energy for the same purpose.

Q Will you please answer my question? *A* I thought I did.

Q Either yes or no. Do you regard a flow of reactive volt amperes as a flow of current?

Mr. Wahrenbrock: Mr. Examiner, I object to an instruction to answer yes or no, unless it can properly so be answered in the witness's opinion.

Trial Examiner: If the witness can answer yes or no, he can say so. That is very common, to use that expression of instruction

to a witness, and it is not at all improper, if the witness can so answer.

[*3068*] *A* No.

Q What do you regard it as? *A* You are equating a current to a k. v. a. They are different characters. One is energy or apparent energy and the other is current. There is no relation between them.

Q Well, what are reactive volt amperes? *A* If you excited a magnet with alternating current and multiplied the voltage by the current, you would get reactive kilovolt amperes, if you measured it with kilovolts, provided there were no losses in the system.

Q Would it not be possible, for instance, that reactive volt amperes were being supplied to a synchronous condenser, for instance, from a generator at one end of the system and the active energy from the other end of the system? *A* It is true that a system can be supplied at one end with reactive k. v. a. and from the other by active k.v.a.

Q And you do not deny, do you, that even at times, when using the wattmeter readings, as you have used them, the indications would be that the flow was in to Hartford from the South Meadow substation, the reactive volt amperes would be flowing in the other direction from Hartford? *A* The instrument would not indicate that.

Q Do you deny the possibility? *A* That they do indicate that there are two currents or two flows of energy in opposite directions at the same time? [*3069*] Yes.

Q I am not attempting to pin you down. I am trying to be definite and not pin you down as to whether it is energy or what. I am talking about reactive volt amperes, call it what you will. Do you deny that it is possible that reactive volt amperes could flow from Hartford to the C.P. line at the same time that the watt-hour meter readings indicate to your mind that all of the flow on those lines going into the transformers at Hartford was in the opposite direction? *A* I can't get clearly the meaning of your question. I can restate my view of that situation.

Q No, I don't want you to restate your view. *A* Well, if you will please restate your question.

Q As I understand, you believe that a certain reading of watt-hour meters will convince you that the flow of active energy on those lines go to the transformers near the 11 k. v. bus at Hartford, toward that 11 k. v. bus. I am correct in that assumption, am I not? *A* May I hear that again? I want to be very sure I have got just exactly what you have said.

* * * * * * [3070]

The Witness: Well, this has gone so far I don't understand the picture of the situation. You have left so much to be inferred, I have lost the particulars of the circuit that you are talking about.

By Mr. Branch: *Q* Isn't the whole basis of your conclusion in regard to the correctness of Mr. Miller's energy flow your premise that the watt-hour meter readings as integrated will show that energy is flowing in a single direction, in the line which goes from the 66 kilowatt line to the 11 k.v. bus in Hartford? A Yes.

Q Well, then, you understand what I mean in saying that the watt-hour meters indicate to you that the electric energy is all flowing in that direction, in that line between the 66 k.v. bus and the 11 k.v. bus? *A* You mean 122 or 123?

Q Yes. *A* Yes.

Q And to your mind, some watt-hour meter readings will indicate that all of the flow on that line is in a single direction, we will say, toward Hartford?

Mr. Wahrenbrock: Mr. Examiner, the questions constantly assume a single line, whereas all the evidence shows there are three feeders, 122, 123 and 124, between the points.

Trial Examiner: I don't think the question goes into [3071] the matter of how many lines there are. I think he is talking about the situation that existed at one time on one of the lines.

Mr. Branch: That is correct, sir. I think every one understands.

Mr. Wahrenbrock: Well, the evidence very clearly shows that

there are totalizing meters, and you have to consider all three lines. Now, what is the purpose of asking about separate lines when the only evidence in the case is with reference to all three lines.

The Witness: May I answer?

Trial Examiner: You may answer the question.

The Witness: The watt-meter, of course, indicates the watts passing in the line in which it is measuring the current.

By Mr. Branch: *Q* And to your mind, that, possibly in connection with other meter readings, would indicate that there was energy flowing only in that direction, in one particular line. Am I correct in that? *A* That is what the instrument shows. The watt-meter shows current flowing in only one direction.

* * * * * *

Q Is it not possible that at the same time the watt- [3072] meter showed that situation on that line, reactive volt amperes might not be flowing in that same conductor in the opposite direction? *A* I will answer that no, and explain what I have in mind by saying that, that when the situation which you set up occurs the fact that there is a tendency for these two energies to flow at the same time results in a resultant flow, which is different from either of the others, but takes care of the thing that is accomplished. The two amperes of reactive components do not flow as entities at the same time in the same wire. They produce a resultant which accomplishes the purpose which was set up, which led to the readings which you speak of.

Q Well, you are familiar with the meters in the South Meadow substation, are you not? *A* Yes.

Q And there is a meter there which does purport to show the direction in which the reactive volt amperes are flowing. That is so, isn't it? *A* That is right.

Q And is it not true that at a time when the watt-hour meter would show the energy flowing in one way, on one of those lines, the meter measuring or showing the direction of flow of the reactive volt amperes would show a flow in the other direction?

A Well, they do flow as components. There is this [*3073*] opposite flow as components. But the net result is a resultant flow in one direction.

Q But my point is one meter does not show one thing in one direction, and at the same time the other meter shows a flow of something else in the opposite direction? *A* It shows a flow of components in one direction at the same time it shows a component flowing in the opposite direction, but neither one represents the actual flow.

Q Now, you have given an illustration which I think you said satisfied your mind as to the correctness of some of your conclusions, in which you took—I have forgotten whether you called it "hunks" of current coming down— *A* A slug.

Q All right. Is that a scientific engineering term? *A* Well, among practical engineers, I think it is.

Q All right. You conceive of a slug of current coming down the Hartford-Agawam line, and you get little slugs being chipped off from it on the way down, is that the conception? *A* Yes.

Q And finally, when you get some of them safely by South Meadow, you find them going out into the C.P. lines 1 and 2, is that correct? *A* That would be a practical engineer's way of expressing it, yes.

Q Now, would the sum of the little slugs, or the chips [*3074*] of the block, all equal the big block that you started off with across the State line? *A* Yes.

Q As a matter of fact, from those readings, how is current measured? *A* I made an illustrative example, and I told you I used current as more easily followed than energy. The measurements there that have been reported have been energy measurements. The same line of reasoning would lead to the same result, using energy as flowing instead of current as flowing.

* * * * * *

Q How is current measured? *A* Ordinarily, with an ammeter.

Q Do you mean to say that the ammeter readings all along the line at different points where you have visualized the little slugs as coming off the big slug, would be equal to the reading which was taken, we will say, at Agawam or some place north? [*3075*] *A* That was my thought.

Q You state it was your thought. Don't you know as a practical matter that very often that is not the case? *A* No; I don't know what you have in mind, but I certainly wouldn't agree to that.

Q Does an ammeter indicate direction of flow? *A* A direct current ammeter does. An alternating current ammeter, taken by itself, does not.

Q Then, any readings that you might make from ammeters in this system, which I think it is agreed has an alternating current, would not indicate the direction of flow of those little slugs, would they? *A* I didn't state that I had made a measurement. I was making an illustration, and showing what would happen when you investigated and found out what the currents were.

Q Well, I must have misunderstood you. I thought you stated that you proved something from some kind of observation of meters, or ammeters, that indicated current flow at various points along the line. Is that not true? *A* I assumed that those currents could be so measured, because my illustration didn't involve the question of how those values would be determined. If you want to know how they could be determined, the power factor and nature of instruments, ammeters and all the other things that might be mixed up in that, I will do my best to help you out. But that is [*3076*] another story.

Q You don't mean to convey the impression then that you have conducted any experiment by actual reading of meters along the line in connection with these slugs of current that bear out your contention, do you? *A* No. My answer was not based on any experiments.

Q You are giving a purely theoretical example, based on certain assumptions, weren't you? *A* Well, I would say it was a

practical engineer's view of it. It was based on assumptions, certainly.

Q Yes. Now, did you understand that Dr. Slepian did not, in reaching his conclusion, give any consideration at all to readings on watt-meters? *A* No. I think I stated that he said the summation of all the watt-meter readings of generation would be the equal of the sum of all the watt-meter readings of loads, considering losses as loads.

Q Did you understand he did not give whatever weight he felt should be attached to all meter readings, or could be placed on watt-hour meters and watt-meters? *A* I didn't intend to intimate that he distrusted the use that is made of meters per se, as a meter, except as he characterized a watt-meter as showing the average for a short time of the watts, instead of the exact value at the instant.

Q Well, you have been here during all the testimony of [*3077*] Dr. Slepian and Dr. Lewis, have you not? *A* That is right.

* * * * * * [*3078*]

Q Didn't you understand both Mr. Lewis and Dr. Slepian to testify that in their opinion it was impossible to demonstrate that there could not be simultaneously counter flow of energy at the same point? *A* I believe they both made that claim.

Q Well, you say you believe that they made it. Are you in any doubt about that? *A* Well, the testimony so indicated. I wasn't going into their minds.

Q You say their testimony so indicated. What do you mean? *A* They made that claim, yes.

* * * * * *

Q Were you present when I asked this question of Dr. Lewis, which appears on page 2314 of the transcript:

> "Would any study based on the information which could be obtained from that log sheet of January 15th, relating to

the first nine hours of the morning, based also on the readings of any other watt meters or watt-hour meters, together with knowledge of the method of operations shown thereon during that time, together with knowledge of ..cation of the meters and [*3079*] the readings made from them, conclusively show that the load at The Connecticut Light and Power Company at Bristol were served exclusively during those hours with energy generated outside of Connecticut, as for example, in Massachusetts, in your opinion?"

Do you recall that question? *A* That sounds very familiar.

Q Well, you recall that Mr. Lewis answered that question, "No"? *A* Yes, I so recall.

Q So it is obvious in regard to Dr. Lewis at least, he was asked to give whatever consideration he felt was proper to the reading of watt-meters and watt-hour meters, was it not? *A* He was asked, I think.

Q Yes. Do you mean—you say he was asked that. Do you mean to state you feel his testimony was not based upon what he felt was proper consideration of readings of watt meters, watt-hour meters?

Mr. Wahrenbrock: That goes into the subjective processes of Dr. Lewis's mind, which I think is not proper cross-examination.

Mr. Branch: I am a little surprised at the nature of this objection, Mr. Examiner, because I think your Honor made it clear when we were discussing the form of questions that should be asked, that the question was what Mr. Lewis testified to, [*3080*] as to his reasons as shown. Now, this witness has given what to me was some indication he felt Dr. Lewis didn't consider these matters, and I think I have a right to bring out that the examination distinctly called these matters to Dr. Lewis's attention, and I am asking him whether in spite of that, his contention is that Dr. Lewis didn't give them consideration.

Trial Examiner: The witness may answer the question.

The Witness: I have lost the question.

Trial Examiner: Read the question back for the benefit of the witness.

(Whereupon the last question as above recorded, was read by the reporter.)

The Witness: He may have considered them proper. I don't know about that.

By Mr. Branch: *Q* Well, I am not sure whether your contention is that he didn't give any consideration to those matters, or whether you just feel that you differ from him as to the interpretation that should be put upon them. *A* I guess it is safe to conclude that I differ.

Q On the interpretation? *A* On the interpretation to be put on that situation, yes.

Q My recollecion of your testimony this morning, sir, is that it included something substantially like this: That [*3081*] you felt that Dr. Slepian omitted the fact that a watt hour meter can show direction of flow of current in a separate circuit, with not more than one source of supply. Does that question indicate to you the testimony to which I refer? *A* I think it does.

Q And will you state, in order that I may not misrepresent you, just what your testimony was in that respect? I mean, in substance. *A* What I had in mind was this, that if, as Dr. Slepian once said, generation in one circuit could be allocated to load in another, that is the denial of the fact that load in the same circuit with generation must come from that generation.

Q Did you not realize that the answers which Dr. Slepian gave in respect to that matter were all theoretical examples which he said could not occur in practice? *A* Well, I agree they couldn't occur in practice, some of them, but just what you mean by "theoretical," I am not sure.

Q Those were all questions which Mr. Wahrenbrock asked on cross-examination, were they not? *A* When you say they were all, I don't know. There were a lot of questions on that matter by Mr. Wahrenbrock.

Q The questions relating to this matter to which we are re-

ferring. *A* If you are talking about the allocation of load out [*3082*] of one circuit on to generation of another, that is true.

* * * * * * [*3083*]

Q Now, as I recall it, you said that you felt that Dr. Slepian failed to give proper regard to certain things which you characterized as "circumstantial evidence." Is that substantially a correct statement?

* * * * * *

The Witness: I referred to it as circumstantial more particularly in view of Dr. Slepian trying to distinguish what [*3084*] was real evidence in the watt meters and what I considered was conclusive indirect proof, going back to the circuits beyond the transmission line, where the different components of currents of the transmission line are in separate circuits.

By Mr. Branch: *Q* Dr. Slepian didn't use the word "circumstantial evidence," did he? *A* No, I applied that as the natural description of his attitude in the matter. He would not accept circumstantial evidence.

Mr. Wahrenbrock: May the witness complete his answer?

Trial Examiner: I think the witness may complete his answer.

The Witness: That finishes it.

By Mr. Branch: *Q* In other words, you make use of what you designate as circumstantial evidence in order to reach your conclusions, do you not? *A* No. I used that word only to indicate a class of evidence outside the transmission conductor, where we have the resultant current, because Dr. Slepian very carefully stated what he considered to be directly observable evidence, and if this other evidence did not constitute directly observable evidence, then I characterized it as "circumstantial" as a convenient term to distinguish what he wouldn't admit as [*3085*] evidence, but what seems to me sufficient proof of flow in certain cases.

Q Did not you yourself characterize the evidence which you felt had been neglected by Dr. Slepian, and on which you relied, as "circumstantial evidence"?

Mr. Wahrenbrock: Mr. Examiner, the question has been asked and answered once or twice before.

Trial Examiner: I think the question may be answered.

The Witness: I introduced the word "circumstantial," but introduced it in illustration of what I would suppose he might term, that he might have used in describing such evidence as that.

By Mr. Branch: *Q* In your direct testimony, you did not indicate, did you that you used the word "circumstantial," because of what you thought Dr. Slepian might characterize it as? *A* I think I did. I used the expression according to Dr. Slepian's point of view, as I remember.

Q Well, according to your point of view, is it circumstantial evidence? *A* No. I don't see why it isn't direct evidence, the same as the other watt-meter readings.

Q You said watt-meter readings do give correct results if they are used properly? *A* Yes.

[*3086*] *Q* And they may give incorrect results if they are used improperly? *A* That is right.

Q And it is no part of the function of the watt-meter at South Meadow station to determine the source of the energy which goes to a particular load, is it?

* * * * * *

The Witness: The watt-meter merely indicates the watts passing in the circuit at the point where the connections are made.

By Mr. Branch: *Q* And it is not intended to indicate the source or the destination of the energy, is it? *A* It is not intended. The watt-meter readings, per se, do not show that. I don't know what you mean by "intended."

Q Well, the purpose of the watt meter is not to enable any one to trace energy from its source to the load where there [*3087*] are several loads and several sources of generation? *A* It might well be. I haven't any particular case in mind. It might well be that purpose.

Q But that isn't the purpose at South Meadow, is it? *A* I presume they put that there to indicate the flow for all purposes, or for any purpose that anyone might have who wanted to read it.

Q But as you understand the arrangements with the customers, such as The Connecticut Light and Power Company, nothing depends upon the source, nothing in their billing depends upon the source from which the energy comes, does it? *A* I haven't looked into their billing.

Trial Examiner: I don't think there is any evidence that this witness is sufficiently familiar with the operating conditions of the plant to know what the purpose was of their placing it there originally.

By Mr. Branch: You have no reason to believe that those watt meters, or watt-hour meters, were placed there for the purpose of enabling anyone to determine from what source energy was supplied to the load at Bristol, for instance?

Mr. Wahrenbrock: Mr. Examiner, I object to that question as not material, what they were placed there for, if they are properly used for the purpose for which they have been used in this testimony, or the testimony supported by this witness's [*3088*] testimony.

Trial Examiner: We will permit the witness to answer the question.

The Witness: I presume they were put there to obtain the indications of the flow for any purpose that anybody wanted to use it for. Of course, I don't know why they were put there. I wasn't there. I don't really know anything about it.

By Mr. Branch: *Q* All right. Now, isn't the basis of the whole disagreement between you, on the one hand, and Dr. Slepian and Dr. Lewis on the other, your contention that there cannot be simultaneously counter flow of energy at the same point, and their contention that there is no proof that that may not be so? *A* Well, that is one difference of opinion. I wouldn't say that was all.

Q If you took their point of view on that, you could not support the power flow diagrams and conclusions of Mr. Miller, as expressed in his exhibit which is No. 62, could you?

Mr. Wahrenbrock: I object to that question as requiring the witness to assume assumptions, or to make assumptions entirely in contradiction with all of his testimony and therefore it is an improper question.

Mr. Branch: I don't think it is improper at all. I think we have a reason for seeing the basis for disagreement.

[3089] Trial Examiner: I think the question is in order.

* * * * * *

The Witness: Well, that conception of theirs is so impossible to my mind, that what the effect of trying to imagine would be, I can't tell. That is, just what would happen if you could have two things going in opposite directions at the same place and the same time, I don't know what the effect of that would be.

Q Didn't you state in your direct testimony when you were called originally that one of the fundamental principles upon which Mr. Miller's conclusions would be supported was that there could be no simultaneous counter flow of energy at a single point? *A* I so understood.

Q Yes. And the whole basis of Mr. Miller's conclusions and your support of those conclusions would fall if that principle doesn't stand. Isn't that correct? *A* No. You asked me that question once before. If that principle didn't stand, you have to have a fresh examination of the situation and see what would happen.

Q But as far as anything that has been done in this case, as far as you know, that is an essential premise for [3090] the conclusions reached by Mr. Miller, is it not? *A* I will say he depended upon it. I wouldn't say that the lack of it would vitiate the results, but he did depend on it. That was one bridge he used.

Q He did depend on it? *A* I say he used it as a bridge.

Q And you supported it by stating that it was a principle which was a bridge? *A* I believe that it was a good strong bridge.

Q Now, have you ever conducted any experiments to determine whether there could be counter flow of energy simultaneously at a given point? *A* I never went into the laboratory and set up an experiment to prove that as a laboratory demonstration, no.

EXHIBITS.

* * * * * * [*3126*]

EXHIBIT 8.

This contract supercedes Cont No. 4336 ARB 1/13/37 No. 5788

This Agreement made this 16th day of December 1936, by and between The Connecticut Power Company, hereinafter called the Seller, and The Connecticut Light and Power Company, hereinafter called the Buyer, both being corporations organized and existing by virtue of the laws of the State of Connecticut.

Witnesseth:

Whereas, the Seller is supplying electric power to the Buyer at Bristol. Connecticut under an agreement dated as of November 1, 1930, and

Whereas, the Seller and the Buyer desire to terminate said agreement and enter into a new agreement relative to the supply of electric power at such point,

Now, Therefore, in consideration of the premises and of the mutual covenants and agreements herein contained the parties hereto covenant and agree with each other as follows:

Article I

It is mutually agreed that the said agreement between the Seller and the Buyer dated as of the first day of November 1930 shall terminate on December 31, 1936.

Article II

Commencing January 1, 1937 the Seller agrees to supply and the Buyer agrees to take and pay for electric power under the terms and conditions as hereinafter set forth.

[*3127*] Article III

The Buyer shall take from the Seller the Buyer's entire requirements of electric power for its Bristol District and the Seller agrees to supply the same. Said electric power shall be in the

form of 3 phase 60 cycle alternating current and shall be delivered and measured at approximately 66,000 volts by suitable metering equipment furnished and installed by the Buyer at the substation of the Buyer in the city of Bristol.

The Seller shall furnish to the Buyer a quality of service, including voltage regulation, frequency and freedom from interruptions, which shall compare favorably with similar service furnished elsewhere by other companies where accepted good practice prevails.

The power factor shall be governed by day to day operating understandings between the Seller and the Buyer and in case of failure to agree the Buyer shall maintain for such reasonable load period or periods as the Seller may from time to time request a power factor of not less than 80% lagging.

Article IV

The price to be paid by the Buyer to the Seller for electric power supplied hereunder shall consist of a demand charge of $1.50 per month per kilowatt of demand and an energy charge of four mills per kilowatt hour for all current delivered plus the sum of $2,000.00 per month, which sum shall be subject to review and adjustment by mutual agreement between the Seller and the Buyer at any time.

[*3128*] Said energy charge is based on the cost to the Seller of fuel equivalent to coal meeting the following specifications

Volatile matter		15 to 23%
Ash		3 to 5%
Sulphur	not to exceed	1.5%
Fixed carbon		71 to 79%
Btu's	about	14,700 per lb

and costing $5.30 per net ton delivered in the bunkers of The Hartford Electric Light Company's power stations at Hartford. Should the cost of fuel on such basis be more than $5.55 or less than $5.05 per net ton, then for each one cent increase above $5.55 or decrease below $5.05 the energy charge shall be in-

creased or decreased respectively by seven ten-thousandths of a cent per kilowatt hour. The average cost of fuel used during the period of any three consecutive months shall determine the amount of such increase or decrease in the energy charge for the next succeeding month.

The method of determining the demand shall be by demand meter, the interval being thirty minutes, and the demand for billing purposes shall be the highest single thirty minute demand as registered by said meter during the last elapsed twelve months.

The price for electric power as set forth herein is based upon the present level of taxation as imposed by existing tax laws insofar as such taxation affects the cost of producing and delivering the electric power covered by this agreement. In the event of substantial variation from such level or in the event of the imposition of any tax clearly earmarked as applicable to the electric power covered by this agreement, such as a gross earnings tax or a sales tax, then said price shall be [*3129*] subject to review and adjustment by mutual agreement in the light of such variation. In case of disagreement as to any such adjustment the matter shall be referred for decision to an arbitrator to be selected by the parties hereto and if they cannot agree upon an arbitrator either party may call upon the Chairman of the Public Utilities Commission to select an arbitrator.

Bills shall be rendered on or about the first day of each month for electric power supplied during the previous month and shall be paid on or before the 15th day of such month.

Article V

The Buyer shall have the right to purchase from the Seller and the Seller agrees to sell to the Buyer, within ninety days after the termination of this agreement, the Seller's tap line from Bristol Junction to the Buyer's Bristol Substation, including the right of way for said tap line and a right of way across the Seller's lines and right of way at Bristol Junction.

The price to be paid for said tap line and rights of way shall be Sixty-two Thousand One Hundred Twenty-five Dollars ($62,-

125.00) plus the cost of additions and betterments made to said tap line and right of way for same subsequent to November 1, 1930, less depreciation at the rate of Eight Hundred Six Dollars and Ninety Cents ($806.90) per year for the period from November 1, 1930 to the date of such purchase.

[*3130*] Article VI

The term of this agreement shall extend until January 1, 1947 and thereafter until the expiration of two years' written notice from one party to the other, which said notice may be given at any time after December 31, 1944.

Article VII

It is mutually understood and agreed that this agreement succeeds and takes the place of all prior agreements, promises or understandings, expressed or implied, relating to the supply of electric power by the Seller to the Buyer at Bristol.

Article VIII

The successors and assigns to the parties hereto shall be entitled to the rights and benefits of and shall be bound by this agreement; but no assignment of the rights of either party shall be valid without the consent in writing of the other. A consolidation or merger of either party with another corporation or the placing of a general mortgage by either party upon its property shall not be construed as an assignment within the meaning of this Article.

In Witness Whereof, the Seller and the Buyer have caused this agreement to be executed in duplicate by their proper officers thereto duly authorized and their respective corporate seals to be hereto affixed the day and year first above written.

THE CONNECTICUT POWER COMPANY

By V E Bird President

Attest R R Dana Secretary

[*3131*] THE CONNECTICUT LIGHT AND POWER COMPANY

By Irvin W Day Vice President

Attest P R Fleming Secretary

STATE OF CONNECTICUT
COUNTY OF HARTFORD ss

Hartford, December 16th 1936

Personally appeared V. E. Bird, President of The Connecticut Power Company signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of The Connecticut Power Company, before me.

EDNA L. NEUMANN
Notary Public

STATE OF CONNECTICUT
COUNTY OF NEW HAVEN ss

Waterbury, December 16 1936

Personally appeared Irvin W. Day, Vice President of The Connecticut Light and Power Company signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of The Connecticut Light and Power Company, before me.

KATHARINE R. STARBUCK
Notary Public

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* * * * * * [3133]

EXHIBIT 10.

THE CONNECTICUT POWER COMPANY
31 Union Street New London, Conn.

January 4, 1940

The Connecticut Light and Power Company, 36 Pearl Street, Hartford, Connecticut.

Gentlemen:

In accordance with your request of January 2nd 1940, we will bill you for power supplied to you at Bristol under the agreement dated December 16th 1936 on the basis of $1.50 per month per kilowatt of demand, plus an energy charge of five mills per kilowatt-hour for all energy delivered, said billing to commence as of January 1st 1940.

It is understood that the first paragraph of Article IV of said

agreement shall be deemed to be amended to conform to this price, and that the additional adjusted payment of $2,000.00 per month, as set out in said paragraph, is hereby eliminated.
Will you please endorse one copy of this letter and return the same for our file?

Yours very truly,
THE CONNECTICUT POWER COMPANY,
A. D. Colvin, Executive Vice President.

Approved and Accepted this day of January 1940.
THE CONNECTICUT LIGHT AND POWER COMPANY,
By R. T. Knowlton.

[*3134*]

EXHIBIT 11.

POWER SUPPLY CONTRACT

No. 3988A-2

August

This Agreement made this 11th day of July, 1930, by and between The Torrington Electric Light Company (hereinafter called the Torrington Company) and The Connecticut Light and Power Company (hereinafter called the Light Company) both being corporations duly chartered by the State of Connecticut, and having their principal places of business in Torrington and Hartford in said State respectively

Witnesseth:

Whereas the Torrington Company and the Light Company entered into a power supply contract dated August 14, 1929, and

Whereas by reason of certain changes now being made in the transmission facilities over which said power supply is transmitted the Torrington Company and the Light Company desire to enter into a new power supply contract to be substituted for and take the place of said contract of August 14, 1929.

Now Therefore, in consideration of the mutuality hereof and the benefits to each party hereto, the said Torrington Company and the said Light Company hereby covenant and agree by and between themselves as follows:

1. The sale and interchange of electric power hereunder shall

be accomplished over the transmission facilities operated by the Light Company under the terms of a separate agreement of even date herewith between the parties hereto to be known as the "Transmission Line Agreement" to which reference is hereby made.

[*3135*] 2. The Light Company agrees to transmit and sell to the Torrington Company and the Torrington Company agrees to take and pay for such surplus electric power as the Light Company has available from the Robertsville Plant of The Winsted Gas Company, if, as and when the Torrington Company can use it.

3. For said surplus electric power the Torrington Company shall pay the Light Company at the rate of eight and one-half mills per kilowatt hour.

4. Said surplus electric power shall be metered and delivered to the Torrington Company at 2300 volts on the step-down side of the Light Company's transformers at the Franklin Street station of the Torrington Company. The Light Company having the facilities will at its own expense test and calibrate the various meters required hereunder. The details of carrying this out to be arranged at the mutual convenience of the parties hereto.

5. The Torrington Company shall sell and the Light Company shall take and pay for firm electric power for delivery to The Winsted Gas Company under the following terms and conditions.

6. It is understood and agreed that the Torrington Company obtains its electric power in whole or in part either from its own steam plant or from The Connecticut Power Company and the supply of firm power for ultimate delivery to The Winsted Gas Company shall be subject to the circumstances, terms and conditions under which the Torrington Company obtains such electric power from The Connecticut Power Company to the extent that the said circumstances, terms and conditions affect the supply destined for The Winsted Gas Company.

[*3136*] 7. Any electric power furnished by the Torrington Company to the Light Company destined for The Winsted Gas Company hereunder shall be construed, for the purpose of fixing the

terms of payment therefor, as having been obtained from The Connecticut Power Company and be sold and metered at 2,300 volts at the Franklin Street station of the Torrington Company, but the Torrington Company may at its own option furnish it in whole or in part from its own steam plant.

8. The price to be paid by the Light Company to the Torrington Company for electric power furnished hereunder shall be based upon the same rate schedule as paid by the Torrington Company to The Connecticut Power Company, as evidenced by the monthly bills from The Connecticut Power Company to the Torrington Company, plus ten percent. The demand of the Light Company for billing purposes shall be its demand at the time of establishment of the billing demand of the Torrington Company. This price may be revised at the end of the first year of this contract at the request of either party hereto.

9. The parties hereto agree to give each other every reasonable aid, assistance and co-operation in regard to the rate, terms, conditions and quality of service of the power supply from the Connecticut Power Company to the Torrington Company, recognizing that both are mutually interested.

10. The parties hereto agree to confer with respect to the increases in capacity required from time to time by the Light Company for supply to The Winsted Gas Company and The Torrington Company agrees to give such [*3137*] notices and take such steps as may be necessary to obtain from The Connecticut Power Company such increases in capacity as may be necessary to meet the load requirements of the Light Company hereunder, provided, however, that the Torrington Company, having in good faith taken the proper steps and performed its part in an effort to obtain satisfactory, adequate and sufficient electric power supply including the requirements of the Light Company hereunder, shall not be responsible to the Light Company for any act of omission or commission on the part of The Connecticut Power Company with respect to said electric power supply.

11. Bills for payments required hereunder shall be rendered monthly and paid within ten days thereafter.

12. If at any time the Light Company shall make a connection between its own transmission system and The Winsted Gas Company direct or through the transmission line which is the subject of the said "Transmission Line Agreement" it may on one year's written notice to The Torrington Company cease taking electric power hereunder.

13. This contract shall take effect as soon as the changes hereinabove referred to in transmission facilities are completed and ready for service, and, unless terminated as in the preceding paragraph provided, this contract shall continue in force until June 1, 1944.

14. Neither party hereto shall assign or otherwise dispose of this agreement or any of its rights or interests hereunder without the written consent of the other party; provided, however, that nothing herein contained shall prevent or limit the right of either party to make a [*3138*] general mortgage in the usual form on any or all of its property, rights, privileges and franchises or to enter into any merger or consolidation, and, in the case of the foreclosure of such mortgage or in case of such merger or consolidation, its rights and obligations hereunder shall pass to and be acquired and assumed by the purchaser or foreclosing mortgagee or the merged or consolidated company, as the case may be.

15. As soon as this contract goes into effect as in paragraph 13 hereof provided, the said power supply contract between the Torrington Company and the Light Company dated August 14, 1929 shall cease and determine.

16. To carry out the purposes of this agreement the Light Company may erect, operate and maintain transformers, switches and other related equipment at the Franklin Street station of the Torrington Company, and the Light Company shall assume all liability for accidents or damages which may be the result of such operation and maintenance of its said apparatus.

In Witness Whereof the parties hereto have caused this agreement to be executed in their name and their corporate seals to be

affixed hereto by officers duly authorized the day and year first above mentioned.

THE TORRINGTON ELECTRIC LIGHT COMPANY
By T M Ulman President

Attest: H. B. Fuessenich, Secretary

THE CONNECTICUT LIGHT AND POWER COMPANY
By Irvin W. Day, Vice President

Attest: W. L. Campbell Secretary.

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* * * * * * [3394]

EXHIBIT 16.

[Stamped:
Federal Power Commission Docketed
Aug 3 1940
Docket Section Secretary's Office JRS
Federal Power Commission
Received Aug. 3 1940]

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION
Docket No. IT-5645
Fishers Island Farms, Inc.

Application of Fishers Island Farms, Inc., for approval and authorization under Section 203, Part II of the Federal Power Act, for the sale of certain facilities to The Fishers Island Electric Corporation.

To The Federal Power Commission.

* * * * * * [3396]

The applicant maintained the necessary equipment, transmission and distribution lines to render service to the residents of Fishers Island as an incident to its real estate development. In 1925, the applicant sold all of the undeveloped land and electric distribution facilities located on the east end of Fishers Island to the Fishers Island Corporation, which was primarily a real estate

development corporation. The applicant continued rendering service, regardless of whether the customer was located on the east end or the west end. The applicant owns two submarine electric cables connecting the Island with the mainland at Groton, Connecticut. The applicant purchases electric power from the Borough of Groton, Connecticut, and by means of the submarine cables transmits the electric energy to Fishers Island where it is distributed to approximately 321 customers. Most of these customers are on the west end of the Island. The requirements of customers for electricity is three times greater in August than in December. The total gross receipts for a year from the electric business are about $64,000.

* * * * * * [*3400*]

After the transfer of the electric utility assets owned by the Fishers Island Farms, Inc., and the Fishers Island Corporation, to The Fishers Island Electric Corporation, a public utility company with a public franchise, such Corporation will carry on the electric business on the whole of Fishers Island previously carried on by the applicant.

F. A general statement briefly describing the facilities owned or operated for transmission of electric energy in interstate commerce or the sale of electric energy at wholesale in interstate commerce is as follows:

The applicant owns the two submarine cables and a tie cable shown on the map, Exhibit M attached hereto, extending from Fishers Island to the Borough of Groton, Connecticut, together with incidental equipment. There are no other facilities used and useful in connection with electric service on Fishers Island, which are operated for transmission of eelctric energy in interstate commerce, or the sale of electric energy at wholesale in interstate commerce.

* * * * * * [*3403*]

Territory and Population

Fishers Island is located on the eastern end of Long Island Sound, about 2½ miles from the Connecticut shore. It is part of

the town of Southold, Suffolk County, and in the parlance of its inhabitants the Island is divided into the so-called east end containing about 1800 acres of land and the so-called west end containing about 1100 acres. The Federal Government maintains a Coast Guard Station on the east end and Ft. Wright is located on the west end.

The approximate year round population at Fishers Island, exclusive of Ft. Wright, is about 700 inhabitants. In summer months the population, exclusive of Ft. Wright, is about 3,000 inhabitants.

History

Electric Operations

In 1889 E. M. & W. Ferguson purchased from the R. Fox estate approximately 95% of the land on Fishers Island.

[*3404*] Through a related company known as the Fishers Island Electric Light, Heat and Power Company, electricity was first supplied in 1899 to the west end of the island where early development occurred. Expenditures for electric plant were recorded on the books of this company until 1908. From January 1, 1908 until June 30, 1918, expenditures for electric plant were recorded on the books of E. M. & W. Ferguson. At June 30, 1918 a reorganization was effected wherein together with other property the electric plant was transferred to Fishers Island Farms, Inc. The latter company was incorporated in March, 1918.

In 1925 Fishers Island Corporation, incorporated March, 1925, purchased from Fishers Island Farms, Inc. the East End, excluding movable property such as meters and property held by other interests. The electric plant acquired was then reconstructed and extended.

From 1899 until 1922 electricity was generated in a small steam-driven generating plant on the west end of the island. In 1922 a submarine cable was installed between Munnatawket on the west end of Fishers Island and Groton Long Point, Conn. This cable was replaced in 1935 because of failure. The generating plant was abandoned after installation of the 1922 cable and thereafter

all power was purchased from the Groton, Conn. municipal system. A similar cable was laid to the east end of the island in 1926. In 1931 Munnatawket substation on the west end and Chocomount substation on the east end were connected by a submarine tie cable. There are now two supply cables between the mainland and the island.

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EXHIBIT 18.

BOROUGH OF GROTON CONNECTICUT

Water and Electric Department
A. N. Tiffany, Superintendent October 18, 1940

Mr. Leon M. Fuquay, Secretary Federal Power Commission Washington, D. C.

Dear Sir:

Upon rereading the copy of my letter of October 17th to you relative to the arrangements we have with the Connecticut Light and Power Company for the supply of power, I find that the last paragraph of the first page and the last two paragraphs of the second page do not convey the correct picture of the situation and I would therefore like to correct any erroneous impressions.

When we were negotiating with the Power Company for a new contract to become effective September 30, 1940, we were told that counsels for the Power Company advised it that the Borough of Groton had no charter rights to sell power to Fisher Island Farms, Incorporated, and that the Power Company knowing of such unauthorized sale should not become a party to such a transaction. They did agree to enter into a contract with the Borough for a supply of power for resale and ultimate use entirely within the chartered territory of the Borough of Groton and outlined the price, terms and conditions of such a proposal, which would result in a substantial decrease in the price of power to the Borough. This proposal is outlined in their letter of June 14, 1940, a copy of which you have.

The power Company has been very cooperative and helpful in making engineering layouts and estimates for a new substation we plan to build for an enlarged supply of power, a substantial amount of which we expect to sell to the Electric Boat Company. They have also offered further engineering assistance in connection with any negotiations we might have with the Electric Boat Co.

The Power Company representatives have also been cooperative in connection with an inquiry we received for breakdown service for the New London Submarine Base, which is located partly in the town of Groton and partly in the Town of Ledyard.

I would like to have these corrections made to my letter of October 17th.

Respectfully yours,

A. N. T. Supt.

BOROUGH OF GROTON WATER & ELECTRIC DEPT.

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* * * * * * [3422]

EXHIBIT 21.

February 27, 1941

Borough of Groton Connecticut

Attention: Water and Electric Department

A. N. Tiffany, Superintendent

Gentlemen:–

Acting on your official notification and request (voted by your Board of Utility Commissioners) as set forth in your letter to Fishers Island Farms, Inc., dated June 4, 1940, this Corporation as assignee of Fishers Island Farms, Inc., proceeded promptly to construct its own source of power on Fishers Island. This construction work was substantially completed on February 9, 1941 and accordingly, no electric energy has been purchased or received from you since February 8, 1941. After midnight on February 28, 1941, it will be unnecessary for you to supply us with any electric energy and you can sever connection with our cable.

We have greatly appreciated doing business with you for the past nineteen years and wish to thank you for your many courtesies.

Very truly yours,

THE FISHERS ISLAND ELECTRIC CORPORATION
By /s/ Henry L. Ferguson President

[*3423*]

EXHIBIT 22.

February 28, 1941

Mr. H. L. Ferguson, Pres. Fishers Island Electric Corp. Fishers Island, New York

Dear Mr. Ferguson:

We sincerely regret that we have been compelled to sever electric connections to the Fishers Island Farms and Fishers Island Electric Corporation with whom we have had very pleasant business relations for a long period of time. However, your instructions of the 27th instant will be carried out Saturday morning, March 1st.

We wish to thank you for your remittance of $2,060.34, for which receipt is herewith inclosed.

Very truly yours,

BOROUGH OF GROTON UTILITIES
Superintendent.

[*3424*]

EXHIBIT 23.

Copy October 23, 1940

Mr. A. N. Tiffany, Superintendent Water and Electric Department Borough of Groton Groton, Connecticut

Dear Mr. Tiffany:

Confirming our telephone conversation of this morning, we will be glad to bill you under the new power rate outlined in my letter

of June 14, 1940 beginning with the service rendered on and after the regular meter reading date about the middle of November, 1940. This will first apply, therefore, to the consumption used between the middle of November and the middle of December.

The demand charge will be based on the highest demand of the preceding twelve months and until such time as the Borough furnishes its own substation, the 11% rental charge on the present substation will be applied as an addition to the rate. The investment charge of 11% on the $5,307.01 investment in the circuit, which was built in 1931 from Chicken Farm Junction to Groton Long Point substation, will cease to be charged beginning with the bill for the service between the middle of October and the middle of November.

If this is in accordance with your understanding of the matter won't you please confirm it.

We would like to again emphasize the need for an early conclusion of the matter of the new substation to supply the Borough and the Electric Boat Company in the event that the Boat Company will require an appreciable amount of service at any early date because of the considerable period of time that will have to elapse from the date of ordering the necessary equipment for the substation and its delivery by the manufacturers. I would suggest that you impress upon the officials of the Electric Boat Company and/or their consulting engineers the fact that whatever necessary substation equipment would be required has got to be ordered from the manufacturers and delivery dates are lengthening on practically all types of equipment.

Yours very truly,

A. V. S. LINDSLEY
Vice President

AVSL/ek

[3425]

EXHIBIT 24.

BOROUGH OF GROTON
Connecticut

Copy October 30, 1940

Mr. A. V. S. Lindsley, Vice Pres. The Connecticut Light and Power Company 250 Freight Street Waterbury, Connecticut

Dear Mr. Lindsley:

We refer to your letter of October 23rd and wish to report that at the regular meeting of the Board of Utility Commissioners of the Borough of Groton, it was agreed that the Board approve and desire the purchase of electric power on the basis of the rate submitted in the afore-mentioned communication.

Very truly yours,

BOROUGH OF GROTON UTILITIES
/s/ A. N. Tiffany Superintendent

[3426]

EXHIBIT 25.

This Agreement made this 16th day of December 1936, by and between The Connecticut Power Company, hereinafter called the Seller, and The Connecticut Light and Power Company, hereinafter called the Buyer, both being corporations organized and existing by virtue of the laws of the State of Connecticut.

Witnesseth:

Whereas, the Seller entered into an agreement with the Central Connecticut Power and Light Company dated August 5, 1930, for the supply of electric power in various towns in Connecticut, and

Whereas, the Buyer is the successor to the Central Connecticut Power and Light Company, and

Whereas, the Buyer entered into a supplemental agreement with the Seller dated February 23, 1933 relative to the supply of electric power at Glastonbury, Connecticut, and

Whereas, the Seller and the Buyer desire to terminate said agreements and enter into a new agreement relative to the supply of electric power,

Now, Therefore, in consideration of the premises and of the mutual covenants and agreements herein contained the parties hereto covenant and agree with each other as follows:

Article I

It is mutually agreed that the said agreements of August 5, 1930 and February 23, 1933 between the Seller and the Buyer shall terminate on December 31, 1936.

[3427] Article II

Commencing January 1, 1937 the Seller agrees to supply and the Buyer agrees to take and pay for electric power under the terms and conditions as hereinafter set forth.

Article III

The Seller agrees to supply such amount of electric power as the Buyer may need for delivery in the East Hampton section of the Buyer's Central District, so called. Said electric power shall be in the form of 3 phase 60 cycle alternating current and shall be delivered and metered at approximately 13,600 volts at the Seller's pole No. 110 at Penfield Hill in the town of Portland.

Article IV

The price to be paid by the Buyer to the Seller for electric power supplied hereunder shall consist of a demand charge of $1.50 per month per kilowatt of demand and an energy charge of 5 mills per kilowatt hour for all current delivered.

Said energy charge is based on the cost to the Seller of fuel equivalent to coal meeting the following specifications

Volatile matter		15 to 23%
Ash		3 to 5%
Sulphur	not to exceed	1.5%
Fixed carbon		71 to 79%
Btu's	about	14,700 per lb

and costing $5.30 per net ton delivered in the bunkers of The Hartford Electric Light Company's power stations at Hartford. Should the cost of fuel on such basis be more than $5.55 or less than $5.05 per net ton, then for each one cent increase above $5.55 or decrease below $5.05 [*3428*] the energy charge shall be increased or decreased respectively by seven ten-thousandths of a cent per kilowatt hour. The average cost of fuel used during the period of any three consecutive months shall determine the amount of such increase or decrease in the energy charge for the next succeeding month.

The method of determining the demand shall be by demand meter, the interval being thirty minutes, and the demand for billing purposes shall be the highest single thirty minute demand as registered by said meter during the last elapsed twelve months.

The price for electric power as set forth herein is based upon the present level of taxation as imposed by existing tax laws insofar as such taxation affects the cost of producing and delivering the electric power covered by this agreement. In the event of substantial variation from such level or in the event of the imposition of any tax clearly earmarked as applicable to the electric power covered by this agreement such as a gross earnings tax or a sales tax, then said price shall be subject to review and adjustment by mutual agreement in the light of such variation. In case of disagreement as to any such adjustment the matter shall be referred for decision to an arbitrator to be selected by the parties hereto and if they cannot agree upon an arbitrator either party may call upon the Chairman of the Public Utilities Commission to select an arbitrator.

Bills shall be rendered on or about the first day of each month for electric power supplied during the previous month and shall be paid on or before the 15th day of such month.

[*3429*] The Seller shall furnish the Buyer a quality of service, including voltage regulation, frequency and freedom from interruptions, which shall compare favorably with similar service furnished elsewhere by other companies where accepted good practice prevails.

Power factor shall be governed by day to day operating understandings between the Seller and the Buyer and in case of failure to agree the Buyer shall maintain, for such reasonable load period or periods as the Seller may from time to time request, a power factor of not less than 80% lagging.

Article V

The term of this agreement shall extend until January 1, 1939 but may be terminated by the Buyer at any time prior to said date upon written notice to the Seller.

Article VI

It is mutually understood and agreed that this agreement succeeds and takes the place of all prior agreements, promises or understandings, expressed or implied, relating to the supply of electric power by the Seller to the Buyer at Glastonbury and at Portland.

Article VII

The successors and assigns to the parties hereto shall be entitled to the rights and benefits of and shall be bound by this agreement; but no assignment of the rights of either party shall be valid without the consent in writing of the other. A consolidation or merger of either party with another corporation or the placing of a general mortgage by either party upon its property shall not be construed as an assignment within the meaning of this Article.

[*3430*] In Witness Whereof, the Seller and the Buyer have caused this agreement to be executed in duplicate by their proper officers thereto duly authorized and their respective corporate seals to be hereto affixed the day and year first above written.

THE CONNECTICUT POWER COMPANY

By V E Bird President

Attest: C B Dana Secretary

THE CONNECTICUT LIGHT AND POWER COMPANY

By Irvin W. Day Vice President

Attest: P. R. Fleming Secretary

STATE OF CONNECTICUT
COUNTY OF HARTFORD ss

Hartford, December 16th 1936

Personally appeared V. E. Bird, President of The Connecticut Power Company signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of The Connecticut Power Company, before me.

EDNA L. NEUMANN
Notary Public

[*3431*] STATE OF CONNECTICUT
COUNTY OF NEW HAVEN ss

Waterbury, December 16, 1936

Personally appeared Irvin W. Day, Vice President of The Connecticut Light and Power Company signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of The Connecticut Light and Power Company, before me.

KATHARINE K. STARBUCK
Notary Public

[*3432*] Copy

THE CONNECTICUT LIGHT & POWER CO.
36 PEARL STREET, HARTFORD, CONNECTICUT

R. H. Knowlton Vice President November 7, 1938

Mr. Viggo E. Bird, President The Connecticut Power Company
Hartford, Connecticut

Dear Mr. Bird:

In accordance with our telephone conversation of this afternoon, reference to our contract with your Company for the purchase of power in our East Hampton section indicates a termination date on or before January 1, 1939. The recent storm which occasioned a vast amount of rehabilitation work calls for a change in the completion date of some of our regular construction projects. We would, therefore, like to postpone the termination of

your supply of power until the first of May, 1939. This will enable us to concentrate our forces on the aforementioned rehabilitation job.

I understood you to say that the May 1st date will be satisfactory to you. We very much appreciate your cooperation.

Very truly yours,

/s/ R. H. KNOWLTON

RHK:W R. H. Knowlton Vice President

[*3433*] Mr. Colvin

November 8, 1938

Mr. R. H. Knowlton, Vice President The Connecticut Light & Power Co. 36 Pearl Street Hartford, Conn.

Dear Mr. Knowlton:

I refer to your letter of the seventh, with reference to the contract with your company for the purchase of power from the Middletown Division of this company for your East Hampton section. This contract is dated December 16, 1936, and has a termination date on or before January 1, 1939.

Your letter indicates a desire to have the termination date extended until the first of May, 1939.

Needless to say, our desire is always to cooperate with you in any possible way we can and we are, therefore, glad to comply with your request in this regard.

Yours very truly,

THE CONNECTICUT POWER COMPANY

V. E. Bird President

[Stamped:]

Received Nov 10 1938 Route

VEB:HV ADC Recd 10 1938 A.D.C. RBC R.B.C.

For Contract File Copy for Gen. File

[3434] Copy

THE CONNECTICUT LIGHT & POWER COMPANY

36 Pearl Street Hartford, Conn.

April 10, 1939

Mr. Samuel Ferguson, President The Connecticut Power Company
Hartford, Connecticut

Dear Mr. Ferguson:

The arrangement which Mr. Day had with your company contemplated discontinuance of your supply of power to us in our East Hampton section January 1, 1939. As a result of the storm we were unable to complete the necessary construction for the taking over of the load on to our system by that date, as recited in my letter of November 7, 1938. Your company, therefore, consented to continue the supply to us until May 1, 1939. I am now advised that we were too optimistic in naming that date, and would like to know whether you can continue the supply until July 1, 1939. We will very much appreciate your consideration.

Very truly yours,

/s/ R. H. KNOWLTON

R. H. Knowlton
Executive Vice President

[3435] April 11, 1939.

Mr. R. H. Knowlton Executive Vice President The Connecticut Light and Power Company 36 Pearl Street, Hartford, Connecticut.

Dear Mr. Knowlton:

I am advised that there are no conditions in Middletown which would cause us any inconvenience in continuing to serve your East Hampton section until July 1, 1939 as requested in your favor of April 10th and, therefore, we are very glad to comply

with your request. We will handle the matter in accordance with your convenience.

Very truly yours,

SAMUEL FERGUSON President

cc: Mr. Colvin Mr. Packard

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* * * * * * [3443]

EXHIBIT 30.

Files 11/19/37 W.D. Eng.

THE CONNECTICUT POWER COMPANY
266 Pearl Street Hartford, Conn.

November 8, 1937.

[Stamped:
[Federal Power Commission Received Nov—9 1937
Rec'd Nov—9 1937 Division of Rates Basis and Valuation]

Federal Power Commission, Washington, D.C.
Att'n: Mr. Jamieson and Mr. Morgan.

Gentlemen:

Pursuant to your request expressed at our informal conference on October 22nd, please find enclosed the following papers:

Six (6) copies of the contracts of this Company with the following companies:

The Hartford Electric Light Company (2 contracts)
The Connecticut Light and Power Company
The Torrington Electric Light Company
(statement only)

Three (3) copies each of a statement showing the monthly sales under the aforesaid contracts from June 1936.

The report of sales contains such information as we are able to furnish. We commenced with the month of June 1936 because that was the effective date of the major contracts. The Connecticut Light and Power Company contract was effective as of January 1st 1937.

As stated before, we feel that these contracts are all intrastate contracts for primary power generated within the State of Connecticut and for distribution within the State.

[*3444*] You inquired about The Bolton Electric Company. This was formerly a subsidiary of The Manchester Electric Company which was wholly owned by The Connecticut Power Company and as of June 30th 1936 both The Manchester Electric Company and The Bolton Electric Company were merged into and with The Connecticut Power Company. The same is true of The Union Electric Light and Power Company. Also, I might add that both these territories are fed by separate lines, 11,000 volt to Manchester and 22,000 volt to Farmington, neither of which are connected except in a very indirect manner with the interconnected 66,000 volt transmission lines.

Let me again express our appreciation of your courtesy in Washington and also our desire to cooperate in any way possible.

Sincerely yours,

AUSTIN D. BARNEY,
Austin D. Barney,
General Counsel.

Encls. ELN.

[*3445*] REPORT ON SALES OF ELECTRIC ENERGY UNDER CERTAIN CONTRACTS OF THE CONNECTICUT POWER COMPANY (OPERATING IN THE STATE OF CONNECTICUT)

[Stamped: Federal Power Commission Received Nov—9 1937
Rec'd Nov 9 1937 Division of Rates Basis and Valuation]

I. Contract with The Hartford Electric Light Company made as of June 1, 1936 as renewed June 7, 1937 and contract with the same Company dated June 8, 1937 relative to covering The Connecticut Power Company's power obligations to The Connecticut Light and Power Company at Bristol, Connecticut.

A. Electric Energy Delivered

1936	KWHrs.	Total Charge
June	305,000	$1,946.24
July	6,000	927.33
August	36,000	1,064.28
September	5,000	282.07
October	776,000	1,798.00
November	936,000	2,195.77
December	2,525,000	6,666.70
7 mos. 1936	4,589,000	$14,880.39
1937		
January	3,703,000	8,542.42
February	1,778,000	4,011.39
March	190,000	438.47
April	3,701,000	10,858.21
May	4,964,000	12,265.29
June	2,477,000	5,934.68
July	703,000	1,761.35
August	—	10.92
September	2,000	133.24
9 mos. 1937	17,518,000	$43,955.97

NOTE: The contract dated June 8, 1937 calls for no delivery of power to The Hartford Electric Light Company. The above table represents transactions only under contract dated as of June 1, 1936 as renewed June 7, 1937.

[*3446*] Demand and Energy Charge: There is no demand charge for power delivered insomuch as The Hartford Electric Light Company does not contract for any primary power. The energy charge is incremental cost which varies from time to time.

Point of Delivery: 11,000 volt Bus at The Hartford Electric Light Company's South Meadow Plant, Hartford, Connecticut.

B. Electric Energy Received

1936	KW Demand Regular	KW Demand Bristol (1)	Demand Charge Regular	Demand for Charge Bristol (1)	KWHrs.	KWHr. Charge	Total
June	22,500	9,160	$15,000.00	$13,740.	23,139,820	$60,957.77	$89,697.77
July	22,500	9,160	15,000.00	13,740.	28,148,300	76,486.54	105,226.54
Aug.	22,500	9,160	15,000.00	13,740.	28,599,200	78,695.72	107,435.72
Sept.	22,857	9,160	15,952.00	13,740.	23,034,760	65,003.83	94,695.83
Oct.	23,992	9,160	18,978.66	13,740.	20,014,589	53,488.11	86,206.77
Nov.	24,559	9,160	20,490.66	13,740.	14,919,713	39,365.31	73,595.97
Dec.	24,559	9,160	20,490.66	13,740.	11,674,213	30,737.83	64,968.49
7 mos. 1936			$120,911.98	$96,180.	149,530,595	$404,735.11	$621,827.09
1937							
Jan.	24,059	13,104	$19,157.33	19,656.	3,178,893	7,219.51	46,032.84
Feb.	24,059	13,104	19,157.33	19,656.	5,825,024	13,763.57	52,576.90
Mar.	24,059	13,104	19,157.33	19,656.	16,247,432	41,164.53	79,977.86
Apr.	23,473	13,104	17,594.67	19,656.	5,252,184	12,910.23	50,160.90
May	23,473	13,464	17,594.67	20,196.	3,826,218	8,993.00	46,783.67
June	23,473	13,536	17,594.67	20,304.	8,853,836	22,852.66	60,751.33
July	23,473	13,536	17,594.67	20,304.	20,492,327	58,912.91	96,811.58
Aug.	23,473	13,896	17,594.67	20,844.	26,022,781	79,726.31	118,164.98
Sept.	23,972	14,544	18,925.33	21,816.	23,225,899	69,706.25	110,447.58
9 mos. 1937			$164,370.67	$182,088.	113,424,564	315,248.97	$661,707.64

Demand Charge:

(a) Under contract of June 1, 1936 for The Connecticut Power Company's own requirements—$180,000 per annum up to total demand of 22,500 (see amendment)—rate of $32.00 per KW per annum for all excess.

(b) Under contract covering Bristol supply dated June 8, 1937 —$1.50 per KW per month.

NOTE: (1) Prior to written contract and from January 1, 1937, The Hartford Electric Light Company was supplying power to The Connecticut Power Company for Bristol on same terms and prior to January 1, 1937 under arrangements superseded by the January 1, 1937 contract.

[3447] Chief Engineer Files 9/17/37 fcs.

THE CONNECTICUT POWER COMPANY
266 Pearl Street Hartford, Conn.

[Stamped: Federal Power Commission Received Sep 13 1937]

September 10, 1937.

Federal Power Commission, Washington, D. C.

Att'n: Mr. Fuquay.

Dear Sir:

Mr. Curran, Secretary of this Company, referred to me your letter of September 7th inquiring about a reply to your letter of June 28, 1937, concerning certain contracts of the Company.

We were under the impression that we had covered the points that you raise in our letter of June 9th. Perhaps our position could be stated more clearly as follows: The contract between The Hartford Electric Light Company and The Connecticut Power Company is a firm power contract for steam station capacity at Hartford. The Connecticut Power Company has no steam station in this section of its territory and The Hartford Electric Light Company has always furnished it with its requirements. The Connecticut Power Company has to obtain sufficient steam capacity for supplying its load on its interconnected system from someone and has always obtained it within the State of Connecticut. It never has had any contract, oral or written, for firm capacity outside of the State of Connecticut, consequently, we do not see how this contract calls for or in any way is connected with the sale of electricity in interstate commerce.

It may be true that some of the energy delivered by The Connecticut Power Company to The Hartford Electric Light Company or to The Connecticut Light and Power Company and The Torrington Electric Light Company may at times have interstate origin by virtue of the operation of the Connecticut Valley Power Exchange. However, there is no contractual relationship between the operation of the Exchange and the intrastate companies in

Connecticut and there is nothing in the specific contracts you have referred to which creates any interstate obligation, either as to sale or transmission. The Exchange agreement, so-called, involves only surplus power when, as, and if available and is in reality merely a voluntary operating plan, subject to termination at will by any of the participating parties [*3448*] and is not in any sense a contract. The very nature of the Exchange transactions are such that no firm power contract could be based thereon.

As to filing any monthly reports on the Form IT-1, the same difficulties arise except more so as were found in reporting the Exchange transactions on this form. There being no direct transactions between companies in respect to any interstate energy, it is impossible to use that form. This was discussed with the Commission in respect to the Exchange and a satisfactory form worked out which has been filed monthly since July 1936. In the case of the contracts under discussion, there is a further difficulty—it would be almost impossible to trace the amount of energy received from outside of the state that might be ultimately delivered to The Hartford Electric Light Company, The Connecticut Light and Power Company at Bristol or to The Torrington Electric Light Company. Even if this was available, which the engineers inform me would be very difficult to obtain in any degree of accuracy in most cases, there is no other information that could be set out on the form IT-1, because the contracts under discussion have nothing to do with any interstate exchange and the transactions thereunder cannot be translated into the information called for by said form. The interstate transactions in which the Company is involved are fully covered by the monthly reports of the Connecticut Valley Power Exchange.

I mention these points illustrative of the difficulties in complying with your request. We desire to cooperate in any reasonable way possible, and I believe the record of this Company as well as that of The Hartford Electric Light Company in supplying information to your Commission from time to time and on the general information reports sent out bears us out in this statement.

If you deem it desirable I should be glad to talk it over with a representative of the Commission and with their Engineers at any time at your convenience.

Sincerely yours,

AUSTIN D. BARNEY,
Austin D. Barney,
General Counsel. 9/13

[3449] Files E Ex 30 See Tr. pg. 603

6029 Jun 28 1937

The Connecticut Power Company, 266 Pearl Street, Hartford, Connecticut.

Attention: Mr. R. B. Curran, Secretary-Treasurer.

Gentlemen:

This will acknowledge your letter of June 9, 1937, inclosing one copy each of your agreements with The Connecticut Light and Power Company, dated December 16, 1936, Hartford Electric Company, dated June 1, 1936, and Hartford Electric Light Company, dated June 8, 1937; and setting forth certain details of your agreement with the Torrington Electric Light Company.

Your letter indicates that your company does not consider the above-mentioned agreements subject to filing under Rule 205 of Federal Power Commission Order No. 44. The reasons advanced to support this contention are that these agreements involve only "the purchase and sale of power between local companies and for local distribution in the State of Connecticut".

As a means of clarifying the above expression, your comment is requested with respect to the following:

By virtue of the agreements of July 1, 1936, and August 1, 1936, your company became a party to the interchange of energy with New England Power Company, Turner's Falls Power and Electric Company, and Central Hudson Gas and Electric Company. It seems probable that some of the energy received from the Hartford Electric Light Company under the agreements of June 1,

1936 and June 8, 1937, would ultimately be delivered to one or more of the companies named above in Massachusetts or New York. It appears even more likely that a portion of the energy delivered by your company to Hartford Electric Light Company under the contract of June 1, 1936, originates outside of the State of Connecticut.

Similarly, energy delivered to the Connecticut Light and Power Company under the agreement dated December 16, 1936, and to the Torrington Electric Light Company, may, in part at least, be derived from sources outside the State. In the case of the Connecticut Light and Power Company, it is recognized that the agreement of June 8, 1937, with the Hartford Electric Company [3450] is expressly intended to cover the supply of energy under this contract. However, energy is delivered by the Hartford Electric Light Company to your company at its South Meadow plant in Hartford and is transmitted over lines which are apparently interconnected with all parts of your system. It is, therefore, conceivable that part of the energy ultimately delivered to the Connecticut Light and Power Company at Bristol is of an interstate character.

In view of the foregoing, it would appear that the contracts which you submit, including the oral agreement with the Torrington Electric Light Company should be filed with the Commission pursuant to Rule 205 of Order No. 44. In addition, a record of the transactions under these agreements should be reported on Form JT-1, as requested.

Very truly yours,

LEON M. FUQUAY
Leon M. Fuquay,
Acting Secretary.

FCJ:emb JM. CAD
6-23-37
Distribution of copies:
Files—2
R. C. & V.—Contract—3
B. of L.—Solicitor
Regional Office—New York

Secretary
Mr. Davenport
A Rumus DT

[3451]

EXHIBIT 31.

CERTIFICATE

This is to certify that the rate at which The Connecticut Power Company is now serving, and has been serving since June 1, 1936, to The Torrington Electric Light Company for electric energy at wholesale is as follows:

Demand Charge of $1.75 per K.W. of maximum yearly demand less an allowance of 2,500 K.W. for steam station capacity held in reserve by The Torrington Electric Light Company/

Energy Charge is nine (9) mills per K.W. Hr. for the first 160 hours use of the demand and five (5) mills per K.W. Hr. for the excess.

THE CONNECTICUT POWER COMPANY,
By V. E. Bird, President.

Dated November 8, 1937.

[3452]

EXHIBIT 32.

April 16, 1936

Mr. Samuel Ferguson, Chairman of the Board The Hartford Electric Light Company Hartford. Connecticut.

Dear Mr. Ferguson:

Following our discussion on April 13th concerning the question of restrictions on the use of the emergency temporary connection which has been made to the Agawam line, I put the matter up to Carmody & Thomas and I enclose copy of their reply and by which I feel we must be guided in the use that is made of the facilities.

Yours very truly,

IWD:KS
Enclosure

Irvin W. Day
Vice President

Mr. King Please note JWD GEK

[NOTE: The second page of Exhibit 32 (p. 3452) is a copy of Exhibit 56 (pp. 3597–3598) printed 1131, 1132, *infra.*]

EXHIBIT 33.

[NOTE: Exhibit 33, pp. 3454–6, is a photostatic reproduction of a carbon copy (on plain paper without the letterhead) of the letter of which Exhibit 48, pp. 3562–3564, printed 1115–1118, *infra*, is a photostatic copy.]

EXHIBIT 34.

[NOTE: Exhibit 34, pp. 3457–3461, is a copy of Exhibit 47, pp. 3557–3561, printed 1107–1113, *infra.*]

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* * * * * * [*3462*]

EXHIBIT 35.

CONNECTICUT VALLEY POWER EXCHANGE

Savings to the C. L. & P. Co.
for Twelve Months Ending August 1935

Sept. 1934	$5,779.44
Oct.	4,938.95
Nov.	9,377.69
Dec.	4,198.38
Jan. 1935	3,895.37
Feb.	3,050.42
March	8,114.33
April	9,870.25
May	9,257.69
June	13,198.37
July	7,487.58
Aug.	4,938.04
Total	$84,106.51

* * * * * * [3463]

EXHIBIT 36.

Copy

The Connecticut Power Company to
Schedule FPC No. 3
Effective Date—June 1, 1936
Filing Date—November 9, 1937

Agreement made as of June 1st 1936 by and between The Hartford Electric Light Company, a duly organized Connecticut Corporation with its principal office in the Town and County of Hartford, State of Connecticut, and The Connecticut Power Company, a duly organized Connecticut Corporation with its principal office in said Hartford, Witnesseth:

Whereas, The Connecticut Power Company owns certain water power plants in the State of Connecticut; and

Whereas, said The Connecticut Power Company requires additional power beyond the capacity of its water power plants for the primary requirements of its own system; and

Whereas, The Hartford Electric Light Company is the owner of steam plants in the State of Connecticut which have sufficient capacity to supply The Connecticut Power Company with its primary needs as hereinafter set out; and

Whereas, the water power plants of The Connecticut Power Company and the steam plants of The Hartford Electric Light Company can be operated in conjunction to serve the combined loads of both companies with greater efficiency than if the facilities of each were applied primarily to the requirements of its own system; and

Whereas, both parties are willing to so operate.

Now, Therefore, in consideration of the premises, the parties hereto agree as follows:

General

1. That the use of water storage at all our plants of both companies shall be under the control of the Load Dispatcher of The Hartford Company in order that the same may be used to the fullest extent possible in caring for short peak loads.

2. In all transactions the obligations and prices (hereinafter set out) for capacity shall be treated as separate and distinct from obligations and prices for energy.

Energy Cost

3. All energy supplied by either party to the other shall be at The Hartford Electric Light Company's incremental cost; the [*3464*] point of delivery or reception by The Hartford Electric Light Company shall be at the 11,000 volt bus at The Hartford Electric Light Company's South Meadow Plant at Hartford, Connecticut, and all energy shall be measured at this point.

Primary Capacity

4. The Hartford Company agrees to supply primary capacity to The Connecticut Power Company as may be required in addition to the capacity of The Connecticut Power Company's own water power plants to carry the present agreed base primary loads of The Connecticut Power Company in the following load centers:

	Base Load
Middletown	6950
Thomaston	1400
Torrington	6400
Housatonic Local—Falls Village	1750
Manchester	4200
Unionville	1800

For this primary capacity The Connecticut Power Company agrees to pay The Hartford Electric Light Company the sum of One Hundred and Eighty Thousand Dollars ($180,000.00) per annum, payable monthly in approximate equal installments.

5. The Hartford Company further agrees to furnish additional capacity as may be required from time to time by The Connecticut Power Company for its primary loads in the load centers set out in Section 4.

For any such additional primary capacity, The Connecticut Power Company agrees to pay the Hartford Company at the rate of Thirty-two Dollars ($32.) per K.W. per annum, payable monthly.

The Connecticut Power Company agrees to maintain suitable measuring instrument for determining the load at the aforesaid load centers which instrument shall be available for inspection by the Hartford Company at all reasonable times. For purposes of determining the increase at the various load centers, the primary load shall be the maximum load recorded for any thirty (30) minute interval and the increase will be the excess of such [*3465*] maximum load over the base load for such load center specified in Section 4. The billing for such additional capacity shall commence the month next succeeding that in which such additional capacity is established.

6. In the event of power shortage from any cause The Hartford Electric Light Company agrees to reimburse The Connecticut Power Company for all capacity it may have to obtain from other sources for the aforesaid load centers to the amount of the cost of such capacity to The Connecticut Power Company.

Term

7. It is mutually agreed that this contract shall be for a year and may be renewed from year to year by written notice by either party which shall be accepted by the other party. It is further agreed that the charges contained herein shall be subject to annual review and may be changed from time to time by mutual agreement of the parties, providing any such change shall be in writing, endorsed by the parties hereto and copy filed with the Public Utilities Commission as may be required by law.

This agreement shall inure to the benefit of the successors and assigns of both parties hereto.

In Witness Whereof, the parties hereto acting by their duly authorized officers have hereunto set their hands and seals as of the day and year first above written.

THE HARTFORD ELECTRIC LIGHT COMPANY,
By V. E. Bird, President.

THE CONNECTICUT POWER COMPANY,
By Allan D. Colvin Vice President.

[*3466*]

The Connecticut Power Company
Supplement No. 1
Effective Date—June 1, 1936
Filing Date—November 9, 1937
to
Rate Schedule FPC No. 3

AMENDMENT TO POWER CONTRACT DATED AS OF JUNE 1ST 1936.

It is mutually agreed that Section 5 of the Power Contract made as of June 1st 1936 by and between the undersigned, be and is hereby amended by the addition of the following:

> Provided no additional capacity shall accrue until the total of the highest measured demands at each load center occurring in any month shall exceed 22,500 K.W. and the additional capacity shall be only the excess of such total over 22,500 K.W.

Nothing herein shall be construed as changing said contract in any other respect.

In Witness Whereof, the parties hereto acting by their duly authorized officers have hereunto set their hands and seals as of the first day of June 1936.

THE HARTFORD ELECTRIC LIGHT COMPANY,
By: V. E. Bird President.

THE CONNECTICUT POWER COMPANY,
By Allan D. Colvin, Vice President.

[3467] Copy

The Connecticut Power Company
Supplement No. 2
Effective Date—November 9, 1937
Filing Date—November 9, 1937
to
Rate Schedule FPC No. 3

THE HARTFORD ELECTRIC LIGHT CO.
266 Pearl Street, Hartford, Conn.

June 7, 1937.

[Stamped: Federal Power Commission Received Nov—9 1937]

The Connecticut Power Company, 31 Union Street, New London, Connecticut.

Gentlemen:

The Agreement made as of June 1st 1936 by and between this Company and your Company relative to the cooperative use of your water power plant and our steam plant and the supplying of primary capacity to you for load centers in Middletown, Thomaston, Torrington, Falls Village, Manchester and Unionville has expired.

Pursuant to Paragraph VII of said Agreement, we hereby notify you that we desire to renew and continue said contract for another year, that is to say until June 1st 1938. If this is agreeable to you, will you please endorse your acceptance of the renewal of said contract on one copy of this letter and return the same to us.

Sincerely yours,

THE HARTFORD ELECTRIC LIGHT COMPANY,

Austin D. Barney,
Vice President–General Counsel.

The Connecticut Power Company hereby accepts the renewal of

the above mentioned contract for a period of one year to June 1st 1938.

THE CONNECTICUT POWER COMPANY,

By Allan D. Colvin Vice President.

[Stamped across face: "Superseded".]

[3468] Copy Files

Connecticut Power Company
Supplement No. 3
Effective Date—
Filing Date—September 1, 1939
to
Rate Schedule FPC No. 3
(Supersedes Supplement No. 2 to
Rate Schedule FPC No. 3)

THE HARTFORD ELECTRIC LIGHT CO.

266 Pearl Street Hartford, Conn.

May 4th 1938

The Connecticut Power Company 31 Union Street New London, Connecticut

Gentlemen:

The Agreement made as of June 1st 1936 by and between this Company and your Company relative to the cooperative use of your water power plant and our steam plant and the supplying of primary capacity to you for load centers in Middletown, Thomaston, Torrington, Falls Village, Manchester and Unionville will expire on June 1st 1938.

Pursuant to Paragraph VII of said agreement, we hereby notify you that we desire to renew and continue said contract for another year, that is to say until June 1st 1939. If this is agreeable to you,

will you please endorse your acceptance of the renewal of said contract on one copy of this letter and return the same to us.

Sincerely yours,

THE HARTFORD ELECTRIC LIGHT COMPANY,

/s/ AUSTIN D. BARNEY
Austin D. Barney
Vice President–General Counsel

The Connecticut Power Company hereby accepts the renewal of the above mentioned contract for a period of one year to June 1st 1939.

THE CONNECTICUT POWER COMPANY,
By /s/ Allan D. Colvin Vice President

[Stamped across face: "Superseded".]

[3469] Copy Files

Connecticut Power Company
Supplement No. 4
Effective Date—June 1, 1939
Filing Date—September 1, 1939
to
Rate Schedule FPC No. 3
(Supersedes Supplement No. 3 to
Rate Schedule FPC No. 3)

THE HARTFORD ELECTRIC LIGHT CO.
266 Pearl Street Hartford, Conn.

May 2, 1939

The Connecticut Power Company 31 Union Street New London

Gentlemen:

The Agreement made as of June 1st 1936 by and between this Company and your Company relative to the cooperative use of your water power plant and our steam plant and the supplying of primary capacity to you for load centers in Middletown, Thomas-

ton, Torrington, Falls Village, Manchester and Unionville will expire on June 1st 1939.

Pursuant to Paragraph VII of said Agreement, we hereby notify you that we desire to renew and continue said contract for another year, that is to say until June 1st 1940. If this is agreeable to you, will you please endorse your acceptance of the renewal of said contract on one copy of this letter and return the same to us.

Sincerely yours,

THE HARTFORD ELECTRIC LIGHT COMPANY,

/s/ AUSTIN D. BARNEY

Austin D. Barney

Vice President–General Counsel.

The Connecticut Power Company hereby accepts the renewal of the above mentioned contract for a period of one year to June 1st 1940.

THE CONNECTICUT POWER COMPANY

FLN By /s/ Allan D. Colvin Vice President

[Stamped across face: "Superseded".]

[NOTE: Pages 3476–3481, inclusive, of this exhibit is a photostatic reproduction of Exhibit 8, pages 3126–3131, printed pp. 1039–1043, *infra.*]

[3470] Files

The Connecticut Power Company
Supplement No. 5
Effective date—June 1, 1940
Filing date—May 4, 1940
to
Rate Schedule FPC No. 3
(Supersedes Supplement No. 4)

THE HARTFORD ELECTRIC LIGHT COMPANY
266 Pearl Street Hartford Conn.

April 22, 1940.

[Stamped: Federal Power Commission Received May 4—1940]

The Connecticut Power Company 31 Union Street, New London, Connecticut.

Gentlemen:

The Agreement made as of June 1st 1936 by and between this Company and your Company relative to the cooperative use of your water power plant and our steam plant and the supplying of primary capacity to you for load centers in Middletown, Thomaston, Torrington, Falls Village, Manchester and Unionville will expire on June 1st 1940.

Pursuant to Paragraph VII of said Agreement, we hereby notify you that we desire to renew and continue said contract for another year, that is to say, until June 1st 1941. If this is agreeable to you, will you please endorse your acceptance of the renewal of said contract on one copy of this letter and return the same to us.

Sincerely yours,

THE HARTFORD ELECTRIC LIGHT COMPANY,

/s/ AUSTIN D. BARNEY
Austin D. Barney
Vice President—General Counsel.

The Connecticut Power Company hereby accepts the renewal of the above mentioned contract for a period of one year to June 1st 1941.

THE CONNECTICUT POWER COMPANY

ELN. By Allan D. Colvin Vice President

[*3471*]

EXHIBIT 37.

This Agreement made this 8th day of June 1937, by and between The Hartford Electric Light Company, hereinafter called the "Seller", and The Connecticut Power Company, hereinafter called the "Buyer", both being corporations organized and existing by virtue of the laws of the State of Connecticut.

Witnesseth:

Whereas, the Buyer is supplying electric power to The Connecticut Light and Power Company at Bristol, Connecticut, under an agreement dated December 16, 1936; and

Whereas, the Seller has been up to the time of this Agreement supplying the Buyer with the necessary electric power for it to perform said contract of December 16, 1936; and

Whereas, the Buyer desires to enter into an agreement for the supply of such electric power as may be required by the terms of said Agreement of December 16, 1936 for a term equal to the term of said contract and the Seller is willing to supply such electric power.

Now, Therefore, in consideration of the premises and of the mutual covenants and agreements herein contained, the parties hereto covenant and agree with each other as follows:

Article I

Commencing as of this day the Seller agrees to supply and the Buyer agrees to take and pay for electric power under the terms and conditions as hereinafter set forth.

[*3472*] Article II

The Seller agrees to supply and the Buyer agrees to take all the Buyer's requirements under Article III of said Agreement of

December 16, 1936 by and between the Buyer and The Connecticut Light and Power Company relative to supplying The Connecticut Light and Power Company with its requirements of electric power for its Bristol District. A copy of said Agreement is attached hereto and reference is hereby made to Article III of said Agreement for a more particular description of the obligations under this Article II.

The quality of service furnished by the Seller shall be equivalent to that required by Article III of said Agreement of December 16, 1936.

Article III

The price to be paid by the Buyer to the Seller for electric power supplied hereunder shall consist of a demand charge of $1.50 per month per kilowatt of demand and an energy charge of the incremental cost per K.W. Hr. of the Seller at its steam generating station located at South Meadow, so-called, in the Town and County of Hartford, State of Connecticut.

The point of delivery for all current shall be on the 11,000 volt (bus) side of the Buyer's 66,000 volt substation located adjacent to said Seller's South Meadow Plant and all energy shall be measured at this point.

The demand shall be the same as determined under the contract of December 16, 1936 between the Buyer and The Connecticut Light and Power Company.

The price for electric power as set forth herein is based upon the present level of taxation as imposed by existing tax laws insofar as such taxation affects the cost of producing and delivering the electric [3473] power covered by this Agreement. In the event of substantial variation from such level, or, in the event of the imposition of any tax clearly earmarked as applicable to the electric power covered by this agreement, such as gross earnings tax or a sales tax, then said price shall be subject to review and adjustment by mutual agreement in the light of such variation. In case of disagreement as to any such adjustment the matter shall be referred for decision to an arbitrator to be selected by the parties

hereto and if they cannot agree upon an arbitrator either party may call upon the Chairman of the Public Utilities Commission to select an arbitrator.

Bills shall be rendered on or about the tenth day of each month for electric power supplied during the previous month and shall be paid on or before the fifteenth day of each month.

Article IV

The term of this agreement shall extend until January 1, 1947 and thereafter until the expiration of two years' written notice from one party to the other, which said notice may be given at any time after December 31, 1944.

Article V

It is mutually understood and agreed that this agreement in no way affects or is connected with an agreement made as of June 1, 1936 by and between the Buyer and the Seller relating to the supply of power to the Buyer for its own requirements and co-operative use of the steam and water power facilities of both parties.

[*3474*] Article VI

The successors and assigns to the parties hereto shall be entitled to the rights and benefits of and shall be bound by this agreement; but no assignment of the rights of either party shall be valid without the consent in writing of the other. A consolidation or merger of either party with another corporation or the placing of a general mortgage by either party upon its property shall not be construed as an assignment within the meaning of this Article.

In Witness Whereof, the Seller and the Buyer have caused this agreement to be executed in duplicate by their proper officers thereto duly authorized and their respective corporate seals to be hereto affixed the day and year first above wri n.

THE HARTFORD ELECTRIC LIGH COMPANY,
V. E. Bird Pres.

THE CONNECTICUT POWER COM ANY
By Allan D Colvin Vice-Pres.

STATE OF CONNECTICUT,
COUNTY OF HARTFORD. June 8, 1937.

Personally Appeared, V. E. Bird President of The Hartford Electric Light Co. Signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of said The Hartford Electric Light Company, before me.

LEONARD DALAY,
Notary Public ADC 4/3/4

[3475] STATE OF CONNECTICUT,
COUNTY OF HARTFORD. June 8, 1937

Personally Appeared, Allan D. Colvin, vice president of The Connecticut Power Company, Signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of said The Connecticut Power Company, before me.

JOHN R. DONAHUE,
Notary Public.

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* * * * * * [3483]

EXHIBIT 39.

An arrangement has been made between the New England Power Company, The Connecticut Power Company and the Turners Falls Power & Electric Company on a day-to-day basis to exchange surplus power so that the lowest available increment cost sources will be used in supplying the combined load. Power will be purchased by the pool at the increment cost to the company furnishing the power, and the decrement saving made by each company receiving the power will be paid to the pool.

From the decrement saving paid into the pool there will be deducted the cost of power furnished to the pool, fixed charges and maintenance on certain existing facilities which have been agreed to be necessary to effect the interchange and the salaries and expense of a small dispatching organization necessary for the opera-

tion of the pool. The resulting monthly savings will be distributed equally between the three members of the pool.

The Connecticut Power Company will act as accounting agent for the pool.

Approved to be effective as from July 1, 1936.

CONNECTICUT POWER COMPANY
By V. E. Bird Pres.

TURNERS FALLS POWER & ELECTRIC COMPANY
By George W. Lawrence President

NEW ENGLAND POWER COMPANY
By F. J. Dunn Vice President

[3484]

EXHIBIT 40.

Saturday, 8-24-35.

C.L.&P. received word to cut away at 8:52 A.M. (per RHB).

Mr. Day called me about 9 A.M. and said he had talked with Mr. Ferguson last evening at 9 P.M. at Fishers Island. Inasmuch as Mr. Ferguson was not ready to cut away at the state lines, he (Mr. Day) was ordering his men to cut the C.P.-New Britain tap. This work had already been started.

Mr. Applegate, Colvin, Whiting, Hunt, Mosher, McKearin and Corey, all these notified by Mr. Mayott.

Arranged to carry on Exchange between H.E.Lt. and T.F.P.&E.

About 10:30 A.M. Mr. Ferguson called stating that it would be necessary to cut the Hartford-Agawam line and the "E" line at the state lines.

Mr. Applegate was to call Mr. Ferguson and make arrangements with him as to cutting the lines.

Called Mr. Day and advised holding off the work on the New Britain tap. One line had already been cut.

Mr. Mosher notified. Mr. Whiting and Colvin notified. Called Corey at Millbury.

Called Poughkeepsie disp. and told them to get in touch with A.T. Gray and have him call me.
Corey called back to check on T.F. load.
Applegate to get in touch with Yale and make arrangements to cut the Agawam line. To have Yale wait for the O.K. from the Exchange.
Applegate told Colvin the "E" line was to be cut.
Hunt called at 11:40 A.M. He said Mr. Ferguson had talked with Mr. Lawrence. Mr. Mosher was arranging with Bell at N.E.P. to carry the T.F. load.
11:58 A.M. Talked with "Courant" reporter. Told him the names of the tie lines. Hartford, Conn. to Agawam, Mass. (The Hartford-Agawam Line) and from Falls Village, Conn. to Poughkeepsie, N.Y. (the "E" line). That the line with C.L.&P. at New Britain was open. The Conn. Power Co. owns the transmission lines. The H.E. Lt. owns no transmission lines. All other transmission lines (interstate) had been cut about a month ago. The tie between the N.E.P. and the Eastern Mass. and the Putnam, Willimantic and Rockville and other miscellaneous customers lines had been cut about a month ago. Didn't know about customers that were fed by out of state companies.
Reporter said Mr. Ferguson had told him to get in touch with Mr. Mayott.
[3485] Called Hunt, Applegate, Day and Gray.
Mr. Mosher said Mr. Ferguson said would be O.K. to cut away Sunday.
They are planning to cut away at 10 A.M. Sunday.
Tried to get Bell and found the office closed.
Tried to get Corey and found he was on his way home to lunch.
(J. C. Kennedy talked over W.E.A.F. and W.T.I.C. at 7:30 P.M. 8-23-35 on the Vicks Vapor Rub hour per F.L. Hunt)
12:16 P.M. Day. Told him Mr. Mosher had gotten in touch with me and said Mr. Ferguson had approved arrangements to cut away about 10:00 A.M. Sunday. Asked Mr. Day if they would

put the line back in service after the line is disconnected, if it would be back in service tomorrow.

The line had been ordered disconnected at New Britain. This is to countermand the order of a few minutes ago telling them to put the line back in service.

12:20 P.M. Applegate. Said O.K. for them to go ahead and cut the "E" line.

Got ahold of Gray in his office.

Mr. Applegate. Mr. Ferguson said O.K. to cut away Sunday at 10 A.M. Told him that Mr. Day is going to cut away and that he (Mr. Day) didn't think that cutting the loop was enough.

12:26 P.M. To Mosher. Told him O.K. to cut away tomorrow at 10 A.M. Told him that Mr. Applegate has talked with Mr. Ferguson and he says it is O.K. Told him that the loop is going to be opened at the state line. A dead span suspended on the Hartford-Agawam line and "E" line. Told him Mr. Day didn't think that opening the loop was enough and didn't constitute a physical disconnection at New Britain. Are going to cut away at New Britain anyway.

12:35 P.M. Mosher. Yale and he had arranged to cut the line at 10:30 A.M.

12:40 P.M. Day. C.L.&P. is going ahead and cut line at New Britain. Mr. Day doesn't agree that cutting loop constitutes actually disconnecting the line.

12:42 P.M., Applegate. Told him 10:30 A.M. Sunday instead of 10 A.M.

Reported that Yale and Mosher are standing by. That they will cut the Hartford-Agawam line. Take down the span. Make disconnection [*3486*] as soon as Applegate says that they are ready. Open loop on Indian Lake span. Yale and Mosher taking care of Hartford-Agawam line. Open loop and physically take span down.

12:50 P.M. Tried to get Gray.

12:50 P.M. To Poughkeepsie disp. Told him to get in touch with

Gray and see if Central Hudson would send linemen out to open the loop on Central Hudson side of Indian Lake span.
Gray called back and said they would do as requested as soon as he talked to Mr. Mac Guinness.
1:05 P.M. Applegate. Reported to him what had been done. He is to report back to Mr. Ferguson.
1:27 P.M. Whiting. Told him that arrangements with Gray had been made to open loop at the Indian Lake span. Told him we are standing by waiting for clearing on the "E" line.
1:30 P.M. Jobert. Said the disconnects opened at Smithfield and getting open on Falls Village side. Waiting to get clearing from Whiting's men.
1:30 P.M. Hartford disp. reported "E" line disconnects at Falls Village are open. That the disconnects on Falls Village side of Smithfield open and section between Falls Village and Smithfield grounded. C.P. line crew notified to proceed disconnecting lines at the state line.
6:20 P.M. "E" line cut out on Conn. side of Indian Lake.
6:00 P.M. Loop opened on C.H. side of the Indian Lake span.
Sunday, August 25, 1935.
9:57½ A.M. Hartford opened the Hartford-Agawam lines.
9:59 A.M. Agawam opened the Hartford-Agawam lines.
9:48 A.M. The C-3 Hartford-Agawam line opened. Grounded at 9:55 A.M. for Benson and Yale to remove span between towers 245 and 249.
10:00 A.M. D-4 Hartford-Agawam line opened. 10:02 A.M. grounded for Benson and Yale to remove span.
11:00 A.M. Tried to get I.W. Day but he was out. Left word to have him call when they got in touch with him.
1:19 P.M. Day called office and got Greene who reported to him that 4 spans of the Hartford-Agawam line were taken down and the "E" line had been opened at both sides of Indian Lake.

C. W. MAYOTT

[3487] Monday, August 26, 1935.

4:30 P.M. Called K.P. Applegate who notified me that the C.P. Co. was going to take down a span this side (Conn. side) of the Indian Lake crossing.

4:35 P.M. Tried to get I. W. Day but he had not gotten back from the Northern Conn. Co.

Tuesday, August 27, 1935.

9:07 A.M. Talked with F. Whiting. C.P. Co. line crew started from Canaan at 7 A.M. to take down the second span on the Conn. side of the Indian Lake crossing. Will take some 6 or 7 hours to do the whole job. Whiting is to send a man out to the job and have all three phases cut at the strain tower immediately.

9:15 A.M. I. W. Day called. Notified him what C. P. Co. was doing. He asked if the C.P. Co. lines could be cut out today, one at a time, long enough to reconnect. I to check with H. E. Lt. and call back. He to check with his organization as to their work.

9:20 A.M. Talked with Douglass. Told him of the above. He can cut out one line at a time when C. L. & P. wishes it. He to get man ready to do switching at 474, etc.

Called I. W. Day and told him the C. L. & P. could get the C. P. lines when they were ready. His men were all ready to work putting up the spans at New Britain. R. Hicock is to handle the C. L. & P. details from now on.

Notified Mr. S. Ferguson of above.

Notified Mr. K. P. Applegate of above.

9:40 A.M. Talked with R. Hicock. C. L. & P. can get one line back in service within 3 or 4 hours. He wanted to know which line H. E. Lt. would prefer first. Got D. Douglass on phone. He preference was No. 2 line. Told Hicock. The first line will be ready about 12:30 P.M. The second about 3 hours later. The C.P. lines will only be out while they are bolting back the loops on the special tower. All switching will go through the regular channels.

9:45 A.M. Told D. Douglass the above.
9:48 A.M. Notified K. P. Applegate that H. E. Lt. would probably be in parallel with C. L. & P. about 12:30 P.M.
10:20 A.M. Talked with F. Whiting and notified him as to what was being done. James Keenan will notify me from Lakeville as soon as the lines are all down.
Notified F. L. Hunt and A. T. Gray that C. L. & P. was reconnecting with the C. P. Co.
[3488] 11:50 A.M. Keenan reported from Lakeville that all three phases of the "E" line has been cut. The third span east of the Lake crossing was taken down (between towers 60 and 61).
Douglass and Hicock notified.
1:07 P.M. No. 2 C.P. line cut out so C.L.&P. could connect back in at New Britain.
2:59 P.M. No. 2 C.P. line cut back in and C.L. & P. phased with H.E. Lt. over this line.
Messrs. Applegate, Ferguson and Bird notified.
3:12 P.M. No. 1 C.P. line cut out to allow C.L.&P. to connect it back in at New Britain.
4:21 P.M. No. 1 C.P. line cut back in at all points including New Britain.
4:40 P.M. K. P. Applegate's office notified that No. 1 C.P. line was back in service.
4:52 P.M. Mr. S. Ferguson notified that No. 1 C.P. Co. line was back in service at New Britain.

Copy [3489]

EXHIBIT 41.

This Agreement made as of the first day of January 1931, by and between The Connecticut Power Company, a Connecticut Corporation with its principal office at Hartford, Connecticut, hereinafter called the Transportation Company, party of the first part, and The Hartford Electric Light Company and The Connecticut Light and Power Company, both Connecticut Corpora-

tions with their principal office at Hartford, Connecticut, hereinafter called the Power Companies, parties of the second part.
Witnesseth:

Whereas, the Transportation Company has built and owns a high tension transmission line running from East Hartford to Suffield, Connecticut (known as the Agawam Line) which line is used by the Power Companies for the purpose of exchanging power between themselves and others; and

Whereas, the use of said line by the Power Companies and/or subsidiaries results in their effecting material fuel savings as well as savings in plant investment; and

Whereas, said high tension line was constructed in order to make possible such savings.

Now, Therefore, in consideration of the premises and the covenants hereinafter set out, the party of the first part and the parties of the second part agree with each other as follows:

Article (I)

The Transportation Company agrees to transmit over said transmission line such amounts of electric energy as may be desired from time to time by the Power Companies up to the capacity of said line.

Article (II)

The Transportation Company agrees to operate said line in accordance [*3490*] with good practice and maintain same in good condition and repair.

Article (III)

The Transportation Company shall, upon request of the Power Companies and upon mutually satisfactory modification of the terms of this Agreement, increase the capacity of said line and make additional investments therein.

Article (IV)

No part of the right-of-way, structures, lines, transformers or substation facilities constituting the said high tension transmission line shall be used by the Transportation Company for purposes other than the exclusive service of the Power Companies,

unless the terms of this Agreement shall have been suitably modified by mutual consent.

Article (V)

The Power Companies agree as follows:

(a) To reimburse the Transportation Company for all taxes of whatever nature which the Transportation Company may be required to pay by reason of the ownership or operation of or business done over said line.

(b) To reimburse the Transportation Company for all expenses incurred in maintaining and operating said line, and for all repairs and replacements of same. There shall not be included in these expenses any item for depreciation, this being provided for under the amortization provisions effective upon the termination of this contract in Articles (VIII) and (IX).

(c) To reimburse the Transportation Company for all claims [*3491*] paid by said Company on account of damage to persons or property arising from the maintenance and operation of said line.

(d) To pay jointly the Transportation Company at the rate of $50,000 per year in lieu of participation in any savings that may be effected through the use of said transmission line. Said payment shall continue during the life of this contract, subject, however, to change under the terms of this agreement as contemplated in Articles (III), (IV) and/or (VIII) hereof.

The Power Companies shall each assume and be liable for only one-half of the payments and obligations due under this agreement to the Transportation Company, unless otherwise specifically provided for herein or modified by reason of the provisions hereof.

Article (VI)

Bills covering the items in Article (V) hereof shall be rendered by the Transportation Company as soon after the first of

each month as practical and will be due and payable on or before the fifteenth of the same month as rendered.

Article (VII)

It is agreed that the investment of the Transportation Company remaining in said line as of January 1, 1931, is Three Hundred and Ninety-three Thousand Seven Hundred and Fifty-six dollars and Twenty-three Cents ($393,756.23), after deducting the sum of One Hundred and Two Thousand Five Hundred and Seven Dollars and Fourteen Cents ($102,507.14) received by the Transportation Company to said date as amortization of its original investment at the rate of [3492] three per cent (3%) annually plus interest at five per cent (5%) compounded annually. The term "line investment" as used in this agreement shall be said sum of Three Hundred and Ninety-three Thousand Seven Hundred and Fifty-six Dollars and Twenty-three Cents ($393,756.23), plus the actual cost of additions and improvements to said line which may hereafter be made in accordance with Article (III) hereof, or less such amounts as may be mutually agreed upon in accordance with Article (IV) hereof.

Article (VIII)

This contract shall continue in force for a period of one (1) year from January 1st 1931 and shall continue thereafter from year to year without further action of the parties hereto, provided, however, either one of the Power Companies may withdraw and terminate this agreement in respect to itself at any time upon three (3) months' prior written notice to the other parties hereto.

Upon the termination or withdrawal from this agreement by either of the Power Companies there shall become due and payable to the Transportation Company by such withdrawing Power Company, either—

(a) If such withdrawal takes place prior to December 31, 1944, such sum as will at five per cent (5%) interest compounded annually, be equal on December 31, 1944, to one-

half of the line investment (as defined in Article (VII) hereof) less one-half of the estimated salvage value of the same; or

(b) If such withdrawal takes place subsequent to December 31, 1944, a sum equal to one-half of the line investment (as defined in Article (VII) hereof) less one-half of the estimated salvage value of the same.

[*3493*] Any Power Company which withdraws from this agreement according to the foregoing provisions at any time prior to the termination of this agreement by both of the Power Companies shall upon three (3) months' prior written notice to the other parties hereto become reinstated as a party hereto without further liability to the Transportation Company for the line investment, unless such line investment has subsequent to such withdrawal been increased pursuant to the provisions of Article (III) hereof, in which case the reinstated company shall be liable hereunder to the Transportation Company for one-half of such increase less one-half of the estimated salvage value of the same.

Article (IX)

This agreement shall be deemed terminated when both of the Power Companies have withdrawn therefrom. The Power Companies upon termination of this agreement shall reimburse the Transportation Company for its line investment (as defined in Article (VII) hereof) less the estimated salvage value of the same as determined by mutual agreement, unless such reimbursement has previously been made under the provisions of Article (VIII) hereof. Such reimbursement shall be made in lieu of any provision in this agreement for annual payments by the Power Companies to the Transportation Company to cover amortization of said line investment.

The Transportation Company shall upon termination of this agreement have the option of either dismantling said line or utilizing it for other purposes.

In the event that the Transportation Company uses said line

for other purposes after termination of this agreement, then the Transportation Company shall reimburse the Power Companies by one of the following methods, the method [3494] to be chosen to be solely at the option of the Transportation Company.

(a) A sum equal to the value of such line for such other purposes as may be determined by mutual agreement or arbitration which sum shall be in no event exceed the amount paid the Transportation Company by the Power Companies under the first paragraph of this Article; said sum to be divided between the Power Companies in proportion to their responsibility for said line investment under the provisions of this agreement; or

(b) Interest at the rate of seven per cent (7%) per year upon said sum. This payment of interest to continue so long as said line shall be used by the Transportation Company for such other purposes.

Article (X)

Arbitration

It is mutually agreed by the parties hereto that any controversy arising out of this contract shall be submitted to arbitration in accordance with the procedure hereinafter set out. This agreement to arbitrate shall apply whether the controversy or controversies shall be between any two parties or all three parties hereto.

The party desiring to arbitrate shall make a written request for arbitration to the other party or parties. Upon such request a single arbitrator may be selected by agreement of all the parties involved in the controversy. If within ten (10) days after date of such request the said parties have not agreed upon any one arbitrator, then the party requesting arbitration may request the Public Utilities Commission of the State of Connecticut to appoint two arbitrators and said arbitrators so appointed [3495] shall choose a third. In the event that the Public Utilities Commission aforesaid shall fail to appoint arbitrators, then the party requesting arbitration may proceed as provided in the statutes of the

State of Connecticut concerning arbitration of disputes. The expense of arbitration shall be borne equally by the parties involved in the arbitrated controversy. It is further mutually agreed that the law of Connecticut shall govern this contract in all respects.

Article (XI)

This agreement shall be binding upon and inure to the benefit of the respective successors and assigns of the parties hereto.

In Witness Whereof, the parties hereto have hereunto set their hands and seals acting by their respective officers thereunto duly authorized as of the day and year first above written.

THE CONNECTICUT POWER COMPANY,
Witness: By Allan D. Colvin Vice-Pres. (SEAL)
V. E. Bird

THE HARTFORD ELECTRIC LIGHT COMPANY,
By S. Ferguson Pres. (SEAL)
V. E. Bird

THE CONNECTICUT LIGHT AND POWER CO.,
By Irvin W. Day Vice President (SEAL)
C. L. Campbell

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* * * * * * [3498]

EXHIBIT 43.

Agreement made this 5th day of August 1930, by and between the Central Connecticut Power and Light Company, a Connecticut Corporation, hereinafter called the Buyer, and The Connecticut Power Company, a Connecticut Corporataion, hereinafter called the Seller,

Witnesseth:

Whereas, the Buyer supplies electric current for power and light to the towns of,—Portland (in part), Glastonbury, Marlboro, Hebron, East Hampton, Haddam, East Haddam, Colchester, and Salem, said territory being known as its northern division; and

Whereas, the Seller is also engaged in the manufacture and

distribution of electric current and supplies the same to other utilities.

Now, Therefore, in consideration of the premises and one (1) dollar in hand each paid to the other, receipt of which is hereby acknowledged, the parties hereto agree as follows:

(I) The Buyer agrees to buy and the Seller agrees to sell all the Buyer's requirements for electric current in its northern division as hereinabove described for the term of this contract, excepting such electric current as may be generated by the Buyer at its own hydro-electric power station located at Leesville in the Town of East Hampton, Connecticut, or as it may purchase from time to time from manufacturing plants which are its customers located in the aforesaid territory, as set out in paragraph (IX) hereof, providing nothing herein shall be construed as permitting the Buyer to buy electric current from any other source.

(II) The Buyer agrees to pay and the Seller agrees to sell such electric current at the following rate:

[3499]

(a) Demand Charge, payable monthly,

$2,100 per year for the first 50 K.W. of demand, or any part,

$24 per year per K.W. for any part of the next 100 K.W. of demand,

$15 per year per K.W. for excess demand;

plus (b) Energy Charge, payable monthly,

1 cent per K.W.hr. for any part of the first 180 hours use of demand,

.8 cent per K.W.hr. for excess use of demand.

Coal Adjustment: In the event that The Hartford Electric Light Company from which power is purchased by The Connecticut Power Company is obliged at any time to pay abnormal prices for coal on account of strikes or other reasons, the right is reserved to apply a fuel adjustment of not more than one mill per K.W.hr. for each dollar per ton of excess price paid.

Minimum Monthly Charge: The demand charge.

Method of Determining Demand: By suitable demand meter, to be located at point of delivery specified in paragraph (III) hereof, the interval being 30-minutes, except where indicated peak demands as determined by test exceed 150% of the 30-minute demand, in which case the demands obtained by test will apply. The demand billed in any month is the highest occurring during the elapsed twelve months. The Buyer may elect for an ensuing twelve months' period that the demand be billed on a monthly basis at an increase of 5% over the yearly demand prices stated above, in which case the demand billed in any month is the highest occurring in that month, subject to a minimum of either 80% of the highest demand occurring in the winter period (October 1st to March 31st, inclusive) of the last 12 months, or 50% of the highest demand occurring in the summer period (April 1st to September 30th, inclusive) whichever is the greater.

(III) The Seller agrees to deliver said electric current at Penfield Hill, Connecticut Power Company Pole No. 110, Portland, at a nominal voltage of approximately 13,600 volts and it is mutually agreed that said electric current shall be measured at that voltage. The energy supplied under this contract is to be three phase, sixty cycle alternating current.

(IV) The Buyer agrees to install a rotary condenser or other equivalent apparatus of suitable size to control its power factor; and further agrees to maintain during the term of this contract, [*3500*] or accept adjustment of demands thereto the following power factor on its system at all hours requested by the Seller:

80% for demands less that 500 K.W.
90% for demands of 500–2,000 K.W., and
95% for demands over 2,000 K.W.

(V) The Seller agrees at its own expense to reinforce its line from its aerial cable in Portland to Penfield Hill sufficient to carry 1500 K.W. at a nominal voltage of 13,600.

(VI) It is mutually agreed that if during the term of this con-

tract it should become desirable or necessary for the Seller to make additional investment in its transmission system for the purpose of supplying the requirements of the Buyer under this contract, the Seller shall not be required by this contract to make such investment unless satisfactory terms can be agreed upon as to sharing carrying charges and the amortization of such investment, provided nothing herein shall be construed as affecting paragraph (V) hereof.

(VII) It is mutually agreed that this contract shall be effective as of January 1st 1930 and that proper adjustments will be made retroactively for this purpose.

(VIII) It is mutually agreed that the term of this contract shall be for fifteen (15) years commencing from said January 1st 1930.

(IX) It is further mutually agreed that the Buyer may acquire further power, from manufacturing plants which are its customers in said territory by lease or purchase, provided any such lease or purchase which may affect the amount of current bought by the Buyer under this contract shall be subject to the reasonable approval of the Seller.

[*3501*] (X) It is mutually agreed that this contract shall be binding upon the successors and assigns of both parties.

In Witness Whereof, the parties hereto acting by their duly authorized officers have caused this contract to be signed in their respective corporate names and their seals affixed hereto the day and year first above written.

CENTRAL CONNECTICUT POWER AND LIGHT COMPANY,
By: Abner Reynolds Treasurer
Allins D Fiske President

Witness:
Earle L Pike
as to AA & ABL.

THE CONNECTICUT POWER COMPANY,
By: Allan D Colvin Vice Pres

Witness:
Grace Nelson

* * * * * * [3502]

EXHIBIT 44A.

THE HARTFORD ELECTRIC LIGHT CO.
266 Pearl Street Hartford, Conn.

Address your reply to the Company and refer to
S. Ferguson Chairman of the Board of Directors
V. E. Bird Pres. E. S. Nutting, Sec'y & Treas., K. P. Applegate, Gen. Mgr.

October 25, 1935

[Stamped: Federal Power Commission Oct 28 1935 Received]

Mr. Frank R. McNinch, Chairman, Federal Power Commission, Washington, D. C.

My dear Mr. McNinch,

Referring to your favor of October 12, and the offer of cooperation toward a restoration of the before-existing interconnections (which we greatly appreciate), would say that we believe all companies concerned would agree to a reconnection of their lines if the Commission would be willing to make an "interpretative" order, subject to revocation at pleasure, along the lines of the attached memorandum.

Such an order would cause all companies concerned, except the Connecticut Light & Power Company and the Hartford Electric Light Company, to become "public utilities", as defined in Section 201(b), and would avoid the economic loss which under present conditions would otherwise exist until a sufficient length of time has elapsed to reassure the directors of the Connecticut Light & Power Company and the Hartford Electric Light Company, both as to the interpretation to be placed on various sections of the Act, and as to the policies to be pursued in the carrying out of the same.

While it is of course uncertain that the courts would construe as "interstate commerce" the past practice of using and permitting the use of plants (without sales of product) not owned or controlled, whenever such use is in the interest of economy, we would

propose to concede the question as to the transfers at points D and E, in the event that the suggested "interpretative" order were to be issued.

Yours very truly,

S. FERGUSON,

S. Ferguson,
Chairman of the Board of Directors

SF:S Encls.

P.S. I should be glad to send a representative at your convenience to discuss any points in the attached memo., which may not be perfectly clear.

Noted BM H.D.J.

[3503] October 25, 1935

[Stamped: Federal Power Commission Oct 28 1935 Received]

Interpretative Order

1 - Power sold or bought by the Connecticut Power Company to or from the Central Hudson Gas & Electric Company at Point E, constitute interstate transactions.

2 - Power sold or bought by the Connecticut Power Company to or from the Turners Falls Power & Electric Company at Point D, constitute interstate transactions.

3 - Sales or purchases of power between intrastate corporations and municipalities at Points A, B, B1, C and F are intrastate transactions.

4 - The transmission lines of the Connecticut Power Company connecting Point A with D, and E with H, are included in the term "facilities" for interstate transmission of power, as used in Section 201(B).

5 - The transmission lines of the Turners Falls Power & Electric Company joining the lines of the Connecticut Power Company at Point D are included in the term "facilities" for interstate transmission of power as used in Section 201(B).

6 – The transmission lines of the Central Hudson Gas & Electric Company joining the lines of the Connecticut Power Company at Point E are included in the term "facilities" for interstate transmission of power as used in Section 201(B).

7 – The Connecticut Power Company, the Central Hudson Gas & Electric Company, the Turners Falls Power & Electric Company are "public utilities" as defined in the Act, since each owns "facilities" under the jurisdiction of the Federal Power Commission.

8 – Transmission lines (other than those specified in (4), (5) and (6)), connecting with Points A, B, B1, C, F and H, are not included in the term "facilities" for interstate transmission as used in Section 201(B).

9 – This interpretative order may at any time be revised or cancelled by the Federal Power Commission, provided the companies affected are given ten days' prior notice of such intent, during which ten-day period the companies affected may, if they so desire, restore their lines to the exclusively intrastate condition existing on August 26, 1935.

[3504] October 25, 1935

[Stamped: Federal Power Commission Oct 28 1935 Received]

Point A—Substation of the Hartford Electric Light Company

This substation of the Hartford Electric Light Company is an integral part of its power plant.

This substation has two functions—

1 – To deliver power generated by Hartford to the Connecticut Power Company. This power is eventually sold by the Connecticut Power Company according to its business necessities to customers both within and without the State.

2 – To receive power purchased from the Connecticut Power Company. The power so purchased may, according to the business necessities of the Connecticut Power Company, have been generated in its own plant or purchased (in

whole or in part) from other companies within or without the state.

Points B & B1—Substations of the Connecticut Light & Power Company

These are points of delivery for power sold by the Connecticut Light & Power Company to the Electric Department of the Town of Groton.

This power is eventually sold by Groton to its customers within the State. One of these customers (Fishers Island Farms) transmits the major portion, but not all of the power so purchased, to Fishers Island, New York.

Point C—Substation of the Connecticut Light & Power Company

This substation is used for two purposes—

1 – To deliver power generated by the plants of the Connecticut Light & Power to its local customers at New Britain, and to the Connecticut Power Company. This latter power is eventually sold by the Connecticut Power Company according to its business necessities, to customers both within and without the state.

and

2 – To receive and distribute within the state power purchased from the Connecticut Power Company, which power may, according to the business necessities of the Connecticut Power Company, have been generated either in its own plant or have been purchased (in whole or in part) from other companies within or without the state.

[*3505*] October 25, 1935

Point D

At this point on the State Line, the transmission line connecting the Connecticut Power Company with the Turners Falls Power & Electric Company, ends.

At this point power is transmitted both into and out of the State.

Point E

At this point on the State Line, the transmission line connecting the Connecticut Power Company with the Central Hudson Gas & Electric Company, ends.

At this point power is transmitted both into and out of the State.

Point F—Substation of Turners Falls Power & Electric Company

This substation is used for two purposes—

1 – To receive and deliver the power of the Turners Falls Power and Electric Company to the Agawam Electric Company, to the United Electric Company at Springfield and to the Connecticut Power Company at the State Line:—

and

2 – To receive and deliver power purchased from the Connecticut Power Company at the State Line to the Agawam Electric Company, to the United Electric Company at Springfield and to the lines of the Turners Falls Power & Electric Company.

Point H—Substation of the Connecticut Power Company

This substation is used for two purposes—

1 – Distribution of power generated at its plant to customers within and without the State.

and

2 – Distribution to customers within and without the State of power purchased within and without the State.

[NOTE: The last page of Exhibit 44-A is a map identical with the last page of Exhibit 47, p. 3561, printed 1113, *infra.*]

* * * * * * [3514]

EXHIBIT 44E.

THE HARTFORD ELECTRIC LIGHT CO.
266 Pearl Street Hartford, Conn.

Address Your Reply to the Company and Refer to
S. Ferguson Chairman of the Board of Directors
V. E. Bird, Pres. E. S. Nutting, Secy. & Treas.
K. P. Applegate, Gen. Mgr.

September 16, 1935

[Stamped: Federal Power Commission Sep 17 1935 Received]

Federal Power Commission Washington, D. C.

Gentlemen:

Acknowledging your order of September 11th, would advise that we have this day received the consent of the Connecticut Public Utilities Commission to our compliance with same as per attached copy.

Referring to your questions in order:—

1—What lines were discontinued?

a—The 66,000 volt lines of the Connecticut Power Company which had previously connected with the system of the Central Hudson Gas and Electric Company in New York State.

b—The 66,000 volt lines of the Connecticut Power Company which had previously connected with the system of the Western Massachusetts Companies in the state of Massachusetts.

2—At what points?

Wires cut and removed at both sides of state line crossings.

3—When?

New York crossing Saturday, August 24, 1935. Massachusetts crossing Sunday, August 25, 1935.

4—Between what companies were connections terminated?

As to physical connections, see No. 1.

As to exchange of power, Hartford Electric Light Company, Western Massachusetts Companies, Connecticut Light and Power Company, Central Hudson Gas & Electric Company, Niagara Hudson Company, New England Power Company and Boston Edison Company.

5—Where energy was being interchanged with other companies did such companies agree to severing connections?
Yes.

[*3515*] 6—Were you correctly quoted as saying that the interconnections discontinued had meant "savings to consumers of power amounting to between two millions and three million dollars"?
Yes. This is an under-estimate of what has been saved to consumers from exchange of power.

(Note: In some press reports the above saving was stated to be an "annual" saving which was not in accord with my statement)

Very truly yours

S. FERGUSON

S. Ferguson
Chairman of the Board

SF:d

[*3516*]

EXHIBIT 45.

THE HARTFORD ELECTRIC LIGHT COMPANY
Hartford, Connecticut

September 17, 1935

Mr. C. L. Campbell, Vice President, Connecticut Light & Power Company, 36 Pearl Street, Hartford, Conn.

Dear Mr. Campbell,

You will probably be interested in the attached correspondence.

also in the fact which I have learned today that the Niagara Hudson have cut their interstate lines.

Yours very truly,

S. FERGUSON,
Chairman of the Board

SF:S Encls.

Encls. Complete file

9/11 Fed. P.C. telegram to Mr. SF
9/13 SF telegram to S.F.
9/13 SF letter to Conn. P.U.C.
9/13 SF letter to F. R. McNinch FPC
9/14 Fed. P.C. telegram to Mr. S. F.
9/16 Conn. P.U. permission to SF
9/16 SF letter to F.P.C.
9/16 SF letter to Conn. P.U.C.

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* * * * * * [3557]

EXHIBIT 47.

Enclosures: 3 – page memorandum (Interstate & intrastate transactions)
1 – map of State of Conn. with transmission facilities therein.

November 19, 1935

Mr. J. Henry Roraback, President, Connecticut Light & Power Company, 36 Pearl Street, Hartford, Connecticut

Dear Mr. Roraback,

We have petitioned the State Commission for approval of the transfer from Hartford to the Connecticut Power Company of all transmission facilities between Hartford and the Massachusetts state line, such as river-crossing towers etc., as a step toward reconnecting the severed connections of the Connecticut Power Company.

It is our plan to later reconnect these lines and to stand on the

proposition that while such connection makes the Connecticut Power Company a "public utility" under the Act, that all transactions in the state between the Connecticut Power Company and other companies are intrastate transactions and do not bring such other companies under the definition.

We hope that you will see your way to take the same position, otherwise it will be necessary to again open the connection between our systems at New Britain prior to such reconnection.

We should be pleased to know of your decision in the matter at your early convenience.

In the event that you wish to separate our systems, the matter can perfectly well wait until the time of the December peak has passed.

Our reason for the above decision is that we believe that the chance of our position being overruled by the courts is too remote to justify the loss of $100,000 a year and the greater plant investment to be shortly required under the present operating conditions.

Attached please find map and memorandum indicating in detail what we believe to be a sound position and one which will be sustained by the courts.

Yours very truly,

S. FERGUSON,
Chairman of the Board

SF:S Encls.

[3558] November 19, 1935

MEMORANDUM – INTERSTATE AND INTRASTATE TRANSACTIONS

1 – Power sold or bought by the Connecticut Power Company to or from the Central Hudson Gas & Electric Company at Point E, constitute interstate transactions.

2 – Power sold or bought by the Connecticut Power Company to or from the Turners Falls Power & Electric Company at Point D, constitute interstate transactions.

3 – Sales or purchases of power within a single state between cor-

porations and/or municipalities of that state at Points A, B, B1, C and F are intrastate transactions.

4 – The transmission lines of the Connecticut Power Company connecting Point A with D, and E with H, are included in the term "facilities" for interstate transmission of power, as used in Section 201 (B).

5 – The transmission lines of the Turners Falls Power & Electric Company joining the lines of the Connecticut Power Company at Point D are included in the term "facilities" for interstate transmission of power as used in Section 201 (B).

6 – The transmission lines of the Central Hudson Gas & Electric Company joining the lines of the Connecticut Power Company at Point E are included in the term "facilities" for interstate transmission of power as used in Section 201 (B).

7 – The Connecticut Power Company, the Central Hudson Gas & Electric Company, the Turners Falls Power & Electric Company are "public utilities" as defined in the Act, since each owns "facilities" under the jurisdiction of the Federal Power Commission.

8 – Transmission lines (other than those specified in (4), (5) and (6)), connecting with Points A, B, B1, C, F and H, are not included in the term "facilities" for interstate transmission as used in Section 201 (B).

[3559] November 19, 1935

Point A—Substation of the Hartford Electric Light Company

This substation of the Hartford Electric Light Company is an integral part of its power plant.

This substation has two functions—

1 – To deliver power generated by Hartford to the Connecticut Power Company. This power is eventually sold by the Connecticut Power Company according to its business necessities to customers both within and without the State.

2 – To receive power purchased from the Connecticut Power

Company. The power so purchased may, according to the business necessities of the Connecticut Power Company, have been generated in its own plant or purchased (in whole or in part) from other companies within or without the state.

Points B & B1—Substations of the Connecticut Light & Power Company

These are points of delivery for power sold by the Connecticut Light & Power Company to the Electric Department of the Town of Groton.

This power is eventually sold by Groton to its customers within the State. One of these customers (Fishers Island Farms) transmits the major portion, but not all of the power so purchased, to Fishers Island, New York.

Point C—Substation of the Connecticut Light & Power Company

This substation is used for two purposes—

1 – To deliver power generated by the plants of the Connecticut Light & Power to its local customers at New Britain, and to the Connecticut Power Company. This latter power is eventually sold by the Connecticut Power Company according to its business necessities, to customers both within and without the state;

and

2 – To receive and distribute within the state power purchased from the Connecticut Power Company, which power may, according to the business necessities of the Connecticut Power Company, have been generated either in its own plant or have been purchased (in whole or in part) from other companies within or without the state.

[3560] Point D

At this point on the State Line, the transmission line connecting the Connecticut Power Company with the Turners Falls Power & Electric Company, ends.

At this point power is transmitted both into and out of the State.

Point E

At this point on the State Line, the transmission line connecting the Connecticut Power Company with the Central Hudson Gas & Electric Company, ends.

At this point power is transmitted both into and out of the State.

Point F—Substation of Turners Falls Power & Electric Company

This substation is used for two purposes—

1 – To receive and deliver the power of the Turners Falls Power and Electric Company to the Agawam Electric Company, to the United Electric Company at Springfield and to the Connecticut Power Company at the State Line:

and

2 – To receive and deliver power purchased from the Connecticut Power Company at the State Line to the Agawam Electric Company, to the United Electric Company at Springfield and to the lines of the Turners Falls Power & Electric Company.

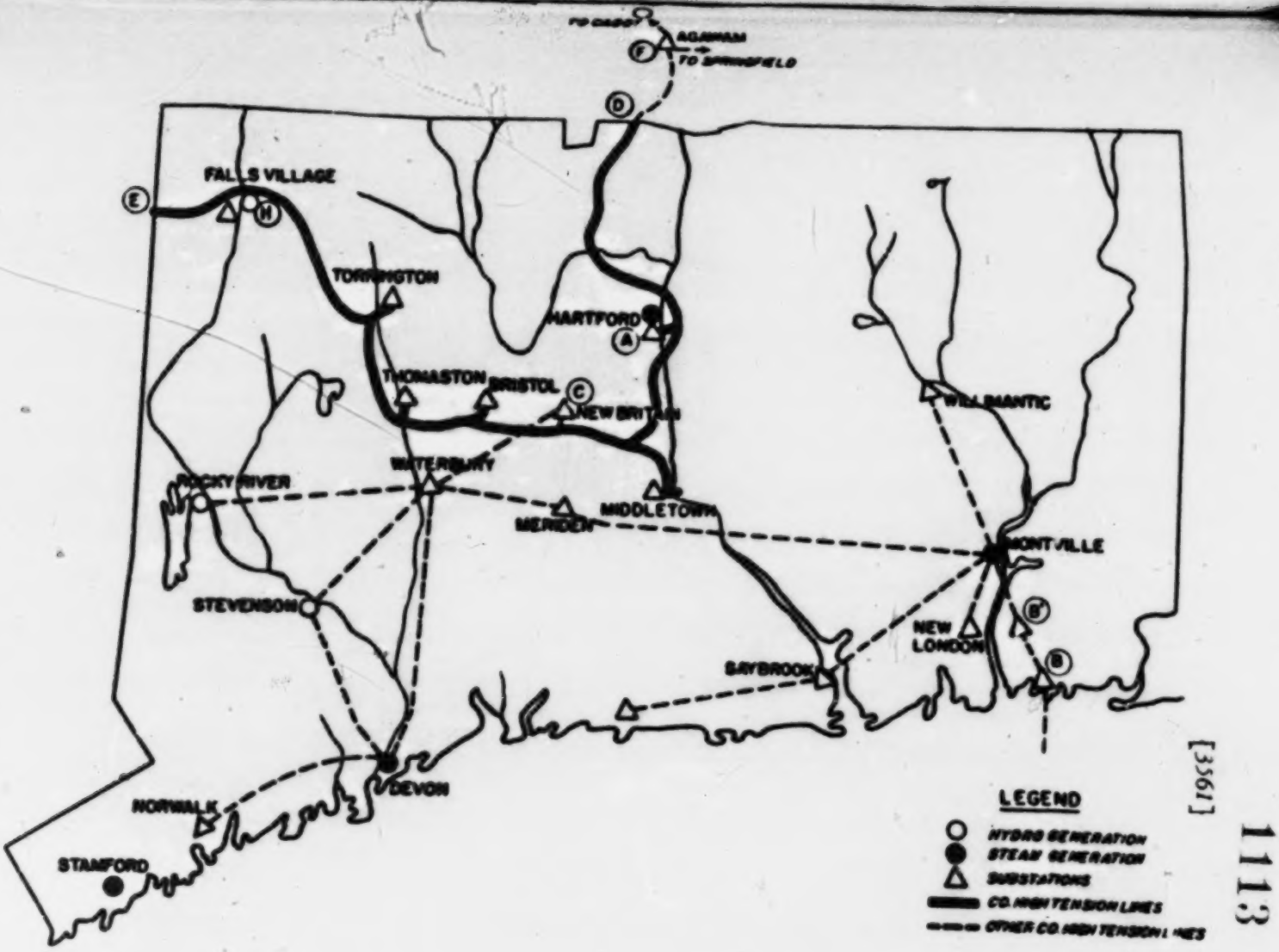
Point H—Substation of the Connecticut Power Company

This substation is used for two purposes—

1 – Distribution of power generated at its plant to customers within and without the State.

and

2 – Distribution to Customers within and without the State of power purchased within and without the State.


TO SPRINGFIELD
FALLS VILLAGE
TORRINGTON
HARTFORD
THOMASTON
BRISTOL
NEW BRITAIN
WILLIMANTIC
WATERBURY
ROCKY RIVER
MERIDEN
MIDDLETOWN
MONTVILLE
STEVENSON
NEW LONDON
BAYBROOK
DEVON
NORWALK
STAMFORD
LEGEND
HYDRO GENERATION
STEAM GENERATION
SUBSTATIONS
CO. HIGH TENSION LINES
OTHER CO. HIGH TENSION LINES

[3561]

EXHIBIT 48.

CARMODY & THOMS
Attorneys at Law
Lilley Building Waterbury Connecticut

Terence F Carmody
William E Thoms
William J Larkin Jr
Walter F Torrance
Maurice T Healey Jr

John D Thoms
Terence C Carmody
Edward T Carmody
Tax Counsel
Alfred C Frodel

Telephones
3 0107
3 0108
3 0109

November 29, 1935.

Mr. J. Henry Roraback, President, The Connecticut Light & Power Company, 36 Pearl Street, Hartford, Conn.

Dear Mr. Roraback:

I have looked over with much interest the letter of Mr. Ferguson, Chairman of the Board of The Hartford Electric Light Company, dated November 19, 1935, and the memorandum and map attached thereto and am glad to get the viewpoint of himself and his company in relation to the controversial questions discussed therein.

As I understand the situation from the engineering standpoint, both with relation to the Agawam line and the so-called Poughkeepsie line, connecting with the Central Hudson Gas & Electric Company, the situation is not so much one of the purchase and sale of power as it is the exchange of power, and that whether the current is received from or sent to New York or Massachusetts depends on varying sets of conditions which may change from day to day or, perhaps, from hour to hour.

As to the situation in relation to Groton, it does not seem to me that this has any bearing on the discussion, as there is no interchange of power, and my thought would be that it would be

better if the reference to Groton and the sale of power there to the local company was eliminated from the memorandum and the map for purposes of discussion of the problems involved.

While I certainly cannot speak with the authority of the Supreme Court, I am afraid that I cannot agree with all of the conclusions in Mr. Ferguson's letter and memorandum, and it seems to me that your company will assume quite a serious risk of coming under Federal jurisdiction if the Agawam and Falls Village connections are remade by the Connecticut Power Company unless your connection at New Britain is cut off.

The real question seems to be whether, under Part II of the Act, these activities described in Mr. Ferguson's [3563] letter are the transmission of electric energy in interstate commerce or the sale of electric energy at wholesale in interstate commerce and the salient point is where the transmission of energy in interstate commerce stops. Perhaps I cannot state the prevailing opinion better than it is stated on page 27 in the book on Operating & Economic Aspects of Public Utility Act of 1935, dated February 18, 1935, and published by the Committee of Public Utility Executives, 60 Broadway, N.Y. The references to Title are a little changed by subsequent changes in the bill, but the interesting part is this:

> "1. Companies are subject to jurisdiction of FPC under Title II if they own or operate (a) transmission facilities used in transmitting energy from a point within a state to a point outside of the state for sale outside of the state, (b) production facilities used in generating energy sold by the generating company or by another company outside of the state, (c) transmission or production facilities connected to the aforesaid transmission or production facilities 'as parts of a system of power transmission situated in more than one state'.
>
> "Apparently the 'power transmission system' is a physical system, irrespective of ownership. Hence it appears that all

companies are subject to Title I who own or operate any part of an interconnected system which extends over more than one state, irrespective of whether any energy generated or transmitted by its own facilities can be identified as going into another state, and irrespective of whether the companies actually transmitting energy over the state line are associated or affiliated companies.

"There is room for much difference of opinion as to what is a 'system of power transmission'. It may mean only that part of an interconnected system in which interstate flow can be identified, but probably the intended meaning would include all of an interconnected system which is so interconnected in normal operation that power could be relayed by substitution to another state. Likewise, it might be construed to include facilities and systems capable of interconnection for emergency or casual interchange but not regularly connected.

"In general it seems probable that most of the important transmission companies in the United States would become subject to FPC jurisdiction under the definition given, since most such systems are interconnected, directly or indirectly, with systems which cross state lines.

[3564] "2. Companies are not subject merely because they conduct retail distribution and sale of energy transmitted from another state, provided they own no transmission lines interconnected with the interstate transmission."

Of course, most of the Supreme Court cases in relation to such matters are gas cases, with relation to taxes and regulation of what was claimed to be transmission in interstate commerce. Perhaps the one which throws the most light upon the subject is Public Utilities Commission *v.* Attleboro, 273 U.S., 89. It seems to be the general tendency in the Courts to hold that interstate transmission ends at the transformer which uses it for the produc-

tion of low voltage currents for distribution in the state and that at that time, and not before, occurs the breaking up of the original package, no matter through whose hands it goes. In the light of the legal uncertainty and the risk of Federal control involved I cannot agree with all of the 8 points in Mr. Ferguson's memorandum. My views with relation to them are as follows:

1, 2, 4, 5, 6 and 7 are probably undisputed.

3 relates to sale, exchange or interchange of power at Agawam, Hartford and New Britain (I think Groton ought to be omitted). I cannot agree that, under all the circumstances, the sale, exchange or interchange of power at these points is certainly purely intra-state. There is a serious risk that it may be held otherwise, and, if it is, you are under the Act.

8. The same conclusions apply to 8 as to 3.

Very truly yours,

WET/B

W E THOMS

[3565]

EXHIBIT 49.

THE HARTFORD ELECTRIC LIGHT CO.
266 Pearl Street Hartford, Conn.

Viggo E. Bird President September 26, 1935

Mr. Irvin W. Day, Vice President The Connecticut Light and Power Company 111 West Main Street Waterbury, Conn.

Dear Mr. Day:

As you may know, we are contemplating transferring to The Connecticut Power Company those transmission lines which might be considered subject to the Federal Power Commission under a recent amendment to the Federal Water Power Act on account of interstate use. This brings up the question as to how much of said lines can be so classified. Our Counsel feels that any interstate character of the Agawam Line can be stopped at the Substation of the South Meadow Plant, and that on the New York line such classification can be stopped at Falls Village.

Insomuch as this is of importance to your company on account of our interconnections, might it not be possible to have a conference between your Counsel and ours in order to see if it can't be determined what lines should be placed with The Connecticut Power Company, so that that company will own all the transmission lines subject to the Federal Power Commission on account of interstate commerce? I suggest that Mr. Mayott sit in at such a conference so as to describe the physical conditions of the transmission system.

In respect to the appeal in the matter of Starquist et al versus The Hartford Electric Light Company, would you like to have your Counsel participate in an advisory capacity so that the procedure of the appeal may be satisfactory to them? This is a case of first impression, and the first appeal under the new statute. It is of importance to all of us that the proper procedure be established, and we feel that it is only proper to invite your cooperation and advice.

Sincerely yours,

V. E. BIRD,

V. E. Bird President

[3566]

EXHIBIT 50.

November 26, 1935

Mr. W. E. Thoms, Carmody & Thoms, Lilley Building, Waterbury, Connecticut.

Dear Mr. Thoms:

As you requested yesterday over the telephone, I am giving you brief outline of the connections of The Connecticut Power Company system with transmission lines extending outside the borders of the State, viz., the so-called Agawam line running into Massachusetts and the Poughkeepsie line running into New York. I am giving the explanation in very non-technical terms.

The Agawam line is built for 110,000 volts, but has been oper-

ated at 66,000 volts, which is the same voltage as is carried on the transmission lines of The Connecticut Power Company and of our own Company. The current coming from Massachusetts is metered as it comes into the plant of The Hartford Electric Light Company in Hartford, so you can picture the meters as the first piece of equipment at the Hartford end of the line. Next comes a so-called auto transformer, which is in effect a regulator. Next are the switches which connect [redacted] line to the system of the Connecticut Power Company, and through the transmission lines of the latter Company it passes New Britain and is there connected to the system of The Connecticut Light and Power Company.

The purpose of the auto transformer at Hartford is to raise or lower the voltage, both for receiving and for transmitting. To illustrate crudely, let us assume that the voltage at the Massachusetts end of the Agawam line is 66,000 volts, and that current is flowing from Massachusetts into Connecticut. It will be received at Hartford with some drop or loss. Let us therefore say that it is received at Hartford at 64,000 volts. Manifestly it must then be brought up to the level of the voltage of the lines of The Connecticut Power Company before it can be, so to speak, taken into that system and the auto transformer is used to raise the voltage from 64,000 to 66,000 volts.

On the other hand, let us assume that current is being sent out from Hartford to Massachusetts. In order that it may be received at Massachusetts at 66,000 volts it will be necessary to dispatch it from Hartford at a higher voltage, let us say 68,000 volts, and the auto transformer is used to accomplish this object.

[3567] There is also another thing to be said, viz., that this current is not, strictly speaking, purchased, but is exchanged, and from hour to hour the current is received from or sent to Massachusetts, depending on a rather complicated set of conditions in the various plants that are so interconnected.

A complicated set of what might be called double entry records or accounts are kept with each of the interconnected companies so

that from hour to hour each Company is debited or credited with the current sort out or received by it, both in terms of kilowatt hours and in dollar values, so that for example, The Connecticut Light and Power Company is debited and credited with blocks of current which it has received or sent out during the month, so that at the end of the month it has a net debit or credit.

Even the above is not a complete picture, because it is a case where in every instance, or almost in every instance, everyone in th pool makes a profit. This may seem a little confusing at first, but fix in your mind that the debits and credits in dollars are exchanged betwen the participants of the pool, but the bogey against which profits are figured is the estimated cost of what it would have cost each participant company if it had been generating its own current and had not been a participant in the pool operations. Thus the exchange of money between the pool participants is something concrete and tangible, while the profits are very real in one sense and imaginary in the other, in that they are figured against an imaginary set of conditions, viz., what it would have cost each Company had it been running alone and on its own.

If I have not made all this clear to you, let me repeat what I have said to others, that I think these pool operations are sufficient to drive any sane man crazy, and I do not believe anybody can understand them unless he is a little crazy anyway.

The Poughkeepsie line condition is a little simpler in that that is one between The Connecticut Power Company and the Poughkeepsie Company only, and although I am not clear whether they buy and sell or merely exchange, I understand, however, that it is an exchange as between the two Companies similar to the Agawam arrangement, but simpler to the extent that there are only two companies involved. The current is received and metered just before it reaches the Falls Village hydro plant, after which it mingles with the current of The Connecticut Power Company.

There is no intervening auto transformer at this point as in the case of the Agawam line.

Yours very truly

AJC:EBF ALEX J. CAMPBELL Special Engineer

P.S. It has been suggested that I should emphasize the fact that the power is not being exchanged at this time and also that I have used the word "savings" instead of "profits".

A J C

[3568]

EXHIBIT 51.

Mr. Day. Perkins, Cocking have copies given to Mr. Davis, Federal Trade Comm. 2/16/32 EKL.

This contract superceded by Contracts No. 5787 and No. 5788 HRB, 1/13/37 No. 4336

This Agreement made as of the first day of November 1930, by and between The Connecticut Power Company, hereinafter called the Power Company, and The Connecticut Light and Power Company, hereinafter called the Electric Company, both being corporations organized under and existing by virtue of the laws of the State of Connecticut,

Witnesseth:

Whereas, the Power Company entered into an Agreement with the Bristol and Plainville Tramway Company dated August 9, 1916 for the sale and purchase of electricity at Bristol, Connecticut, and an agreement dated March 24, 1917 for the operation of a condenser at said Bristol; and

Whereas, the Power Company entered into Agreements with The Eastern Connecticut Power Company for the purchase and sale of electricity at New London, Connecticut, dated March 27, 1920 and November 16, 1922; and

Whereas, The Bristol and Plainville Tramway Company and The Eastern Connecticut Power Company have been merged into

the Electric Company so that it is the successor in interest to said companies; and

Whereas, said agreements have been variously amended and modified from time to time and it is deemed advisable at this time to make a new agreement.

Now, Therefore, in consideration of the premises and for the sum of One (1) Dollar and other considerations each to the other paid, receipt of which is hereby acknowledged, and of the mutual covenants and agreements herein contained, the parties hereto covenant and agree with each other as follows:

Article I

The Power Company agrees to supply and the Electric Company agrees to take and pay for at Bristol, and the Electric Company agrees to supply and the Power Company agrees to take and pay for at New London, electric power as defined under and subject to the terms and conditions hereinafter set forth.

[3569] Article II

(a) Contract Demand

The initial contract demand hereunder of the Electric Company at Bristol shall be ten thousand (10,000) K.W. subject, however, to reduction as hereinafter set out.

The initial contract demand of the Power Company at New London shall be six thousand (6,000) K.W. or the highest actual demand in any month occurring during the last elapsed twelve (12) months if such actual demand is higher or lower than six thousand (6,000) K.W.

The method of determining the demand shall be by demand meter, the interval being thirty (30) minutes.

It is agreed that as the contract demand of the Power Company hereunder shall increase at New London over and above six thousand (6,000) K.W., the contract demand of the Electric Company at Bristol shall be decreased by a similar amount, such adjustment to be made annually as of November 1st.

(b) Rate

The rate shall be the demand charge plus the energy charge.

The demand charge shall be $18.00 per year per K.W. of contract demand, payable in equal monthly installments whether or not any current is used.

The energy charge shall be four (4) mills per Kw-hr. for all current delivered at New London and all contract current delivered at Bristol.

Article III

The Electric Company agrees to take at Bristol initially thirty million (30,000,000) Kw-hrs. per year (in approximately equal monthly installments) and proportionately less as the contract demand at Bristol is reduced below ten thousand (10,000) K.W. Such number of Kw-hrs. is herein referred to as the contract current delivered at Bristol.

Inasmuch as the electric power supplied hereunder at Bristol by the Power Company and the electric power supplied hereunder at Bristol by the Electric Company will be so intermingled as to make it [*3570*] impossible to meter the same separately, it is mutually agreed that, of the total Kw-hrs. supplied at Bristol in any month, that portion up to the monthly installment of contract current shall be considered as having been supplied by the Power Company and any Kw-hrs. in excess of said portion as well as any demand in excess of the contract demand shall be considered as having been supplied by the Electric Company.

For purposes of identification, the monthly installment of contract current shall be the first two and one-half million (2,500,000) Kw-hrs. used by the Electric Company at Bristol and proportionately less as the contract demand varies from time to time.

The Power Company agrees to supply said contract current at Bristol in the monthly installments specified.

The Power Company agrees to take at New London its entire requirements of electric power in its New London division and the Electric Company agrees to supply the same.

Article IV

Delivering and Metering

(a) All electric power furnished hereunder by the Power Company at Bristol shall be delivered at a normal primary voltage of sixty-six thousand (66,000) volts and shall be alternating, three (3) phase current at a frequency of approximately sixty (60) cycles per second. All such current shall be delivered to the Electric Company at the substation of the Electric Company in Bristol, Connecticut, and shall be measured on the high tension side of the Electric Company's transformers located in said substation.

(b) All electric power furnished hereunder by the Electric Company shall be delivered at a normal primary voltage of thirty-three thousand (33,000) volts and shall be alternating, three (3) phase current at a frequency of approximately sixty (60) cycles per second. Such current shall be delivered to the Power Company at the Williams Street Substation of the Power Company in New London, Connecticut, and at such other points as shall be mutually agreed upon, and shall be measured on the high tension side of the Power Company's transformers located at such points of delivery.

[3571] (c) Voltage regulation and power factor shall be governed by day to day operating understandings between the Power Company and the Electric Company. In case of failure to agree with respect to the voltage, it shall at the point of delivery be not less than sixty thousand (60,000) volts at Bristol and not less than thirty thousand (30,000) volts at New London, respectively. In case of failure to agree with respect to the power factor, the receiving company shall maintain for such reasonable load period or periods as the supplying company may from time to time request, a power factor of not less than eighty (80) per cent lagging.

(d) Metering shall be done by suitable metering equipment and such equipment shall be subject to inspection by either company at all times upon reasonable notice. The metering equipment at

Bristol shall be installed and owned by the Electric Company, and the metering equipment for measuring the supply to the Power Company shall be installed and owned by the Power Company. Any testing and calibration necessary shall be done by the company owning the equipment and the expense of same shall be borne equally by the two companies.

(e) Each company shall furnish to the other a quality of service, including voltage regulation, frequency and interruptions, which shall compare favorably with similar service furnished elsewhere by other companies where accepted good practice prevails.

Article V

Billing

Each company shall on or about the first day of each month render to the other company a bill for the services furnished as herein provided for during the previous month and payment for such bill shall be made on or before the fifteenth day of such month.

Article VI

Line Reconstruction

The Power Company agrees to rebuild at its expense its tap line from Bristol Junction into Bristol and make such changes in the line [*3572*] between New Britain and Bristol as may be necessary, in both cases, in the joint judgment of the engineers of the two companies, to safeguard the service at Bristol.

The Electric Company agrees at its expense to make such changes in its lines from Montville to New London as will, in the joint judgment of the engineers of the two companies, safeguard the service at New London.

Article VII

It is mutually agreed that in the event the amount of electric current to be transported by the Power Company for the Electric Company over the Power Company's lines between New Britain and Bristol over and above the contract amount becomes a burden on the Power Company's ability to take care of its own business

over said lines, which matter shall be in the sole but reasonable judgment of the engineers of the Power Company, then the Electric Company shall build its own line from Frost Bridge, so-called, to Bristol or to Thomaston, or shall otherwise remedy the condition within one (1) year after written notice from the Power Company.

Article VIII

(a) The Electric Company shall have the right to purchase from the Power Company and the Power Company agrees to sell to the Electric Company the tap line from Bristol Junction to Bristol referred to in Article VI hereof including the right of way for same either within ninety (90) days after the termination of this agreement or in the event that the Electric Company builds its own line to Bristol as provided for in Article VII hereof.

The price to be paid for said tap line and right of way shall be $62,125.00 (the present book value of said tap line and right of way, plus the cost of additions and betterments made to said tap line and right of way subsequent to November 1, 1930, less depreciation at the rate of $806.90 per year for the period between November 1, 1930 and the date of such purchase.

It is understood and agreed that, in the event the Electric Company purchases said tap line and right of way prior to the termination of this [3573] agreement, it may become desirable or necessary to change the place of delivery of the electricity furnished hereunder by the Power Company and to make other modifications in the provisions of this agreement in order to adjust equitably for the new conditions of supply, but such modifications shall not be construed as changing the method of determining the amount of primary power to be supplied by the Power Company or the rate to be paid for same by the Electric Company.

(b) The Electric Company owns a right of way from Cohanzie Junction to the Williams Street Substation of the Power Company at New London together with two transmission lines built thereon, one a double circuit line over which electric power is supplied to the Power Company, the other a single circuit line.

The Power Company shall have the right to purchase from the Electric Company and the Electric Company agrees to sell to the Power Company within ninety (90) days after the termination of this agreement said two circuit transmission line of the Electric Company from Cohanzie Junction to New London including the right of way; provided, however, that the Electric Company may, in conveying said right of way to the Power Company, reserve the right to use said right of way jointly with the Power Company for its single circuit transmission line or any substitute therefor in order that the Electric Company may fulfill any obligations it may have for the supply of electric power to The Connecticut Company, its successors and assigns at New London.

The price to be paid for said line and right of way shall be $31,382.00 (the present book value of said line and right of way) plus the cost of additions and betterments made to said line and right of way subsequent to November 1, 1930, less depreciation at the rate of two per cent per annum on the cost of such additions and betterments.

Article IX

The contracts specified in the preambles of this agreement are hereby terminated as of October 31, 1930, and it is mutually understood and agreed that this agreement succeeds and takes the place of all prior agreements, promises or understandings, expressed or implied, relating to the supply of power by the Power Company to the Electric Company at Bristol and by the Electric Company to the Power Company at New London.

[*3574*] Article X

The Power Company further agrees to transport over said lines from New Britain to Bristol such other electric power with suitable allowance for line losses as may be supplied by the Electric Company for use in Bristol over and above that bought hereunder from the Power Company, up to the capacity of said lines as rebuilt and subject to Article VII hereof.

In consideration of rebuilding said lines and as a transportation fee, the Electric Company agrees to pay the Power Company the

sum of four thousand (4,000) dollars per annum (in equal monthly installments) during the term of this contract; provided, however, that in the event the Electric Company purchases the Power Company's tap line from Bristol Junction into Bristol as provided in Article VIII hereof, the Electric Company shall be relieved of further payment of said annual sum of $4,000.00.

Article XI

Arbitration

In case of any dispute arising as to the interpretation of this contract or any portion thereof or as to the adjustment of any claim, or as to any other matter hereunder, it shall be a condition precedent to the bringing of any action, suit or proceeding, whether at law or in equity, concerning such dispute, that the same shall first be referred for decision to an arbitrator, or in case at the end of ten (10) days after a request by any party for an arbitrator, the parties have not agreed upon a single arbitrator, to three (3) arbitrators, one appointed by the Electric Company, one by the Power Company, and the third by the two thus named. In case either the Electric Company or the Power Company shall fail to name a second arbitrator within ten (10) days after the naming of the first arbitrator, the first arbitrator shall be the sole arbitrator. In case of a failure by the two arbitrators to name a third arbitrator within ten (10) days after the appointment of the second arbitrator, the party requesting the arbitration shall within ten (10) days request any court which would have jurisdiction of a suit concerning the matter in dispute to name, and such court may thereupon name, the third arbitrator within fourteen (14) days thereafter. The three arbitrators, however named, may act by a majority; and the arbitrator or arbitrators, as the case may be, shall forthwith hear the parties after notice to the Electric [*3575*] Company and to the Power Company, shall consider and decide the dispute, and shall at once notify the Electric Company and the Power Company in writing of their decision. Such decision shall be binding upon the parties, and the expenses of the arbitration

proceedings shall be borne equally by the Electric Company and the Power Company.

Article XII

Successors and Assigns

The successors and assigns of the parties hereto shall be entitled to the rights and benefits of and shall be bound by this Agreement; but no assignment of the rights of either party shall be valid without the consent in writing of the other. A consolidation or merger of either party with another corporation or the placing of a general mortgage by either party upon its property shall not be construed as an assignment within the meaning of this paragraph.

Article XIII

Term

This agreement shall be binding upon the parties hereto until February 17, 1943.

In Witness Whereof, the Power Company and the Electric Company have caused this instrument to be executed in duplicate by their proper officers thereto duly authorized and their respective corporate seals to be hereto affixed as of the day and year first above written.

THE CONNECTICUT POWER COMPANY

By S. Ferguson Pres

THE CONNECTICUT LIGHT AND POWER COMPANY

By Irvin W Day Vice Pres.

Winesses for both signatures
V. E. Bird
Leland D Colvin

[3576] STATE OF CONNECTICUT,

COUNTY OF HARTFORD. ss. November 3, 1930.

Personally Appeared S. Ferguson Prest of The Connecticut Power Company signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of The Connecticut Power Company, before me.

JOHN E LYNER

Notary Public.

STATE OF CONNECTICUT,
COUNTY OF HARTFORD. ss. November 3, 1930.

Personally Appeared Irvin W Day Vice Pres of The Connecticut Light and Power Company signer and sealer of the foregoing instrument and acknowledged the same to be his free act and deed and the free act and deed of The Connecticut Light and Power Company, before me.

O. M. C. LYNES
Notary Public.

---

* * * * * * [3597]

EXHIBIT 56.

CARMODY & THOMS
Attorneys at Law
Lilley Building Waterbury Connecticut

Terence F Carmody
William E Thoms
William J Larkin Jr
Walter F Torrance
Maurice T Healey Jr

John D Thoms
Terence C Carmody
Edward T Carmody
Guerin B Carmody

Tax Counsel
Alfred C Frodel

Telephones
5 0107
5 0108
5 0109

April 16, 1936.

Mr. Irvin W. Day, The Connecticut Light & Power Company,
Waterbury, Conn.

Dear Sir:

We have your letter of April 13th, in relation to the Hartford-Agawam transmission line which was reconnected on March 18, 1936, as a result of the emergency created by flood conditions on the Connecticut River.

On reading carefully Title II, Part II, Section 202d of the Public Utility Act of 1935, you will note that companies may, without coming under the jurisdiction of the Commission, during

the continuance of any emergency, construct temporary facilities for the transmission of energy in interstate commerce necessary or appropriate to meet such emergency and that the temporary connection shall be discontinued upon the termination of such emergency.

What you say about the interchange of power for economical reasons, as long as the connection is maintained, may have some merit from the financial standpoint and it is true that the paragraph in question does not restrict, in explicit terms, the use of such power furnished through the temporary connection to its use for emergency purposes, nevertheless, to use it for other purposes would seem to be in contradiction to the whole spirit and purpose of the act. It is difficult to see why your company, which has no such emergency, could properly participate in an exchange of power, by which you received energy which you did not require on account of an emergency, as far as you were concerned. Such is not the purpose of this exception to the jurisdiction of the act.

Our rather earnest conviction is that this connection should be utilized only for the furnishing of such power by your company as is necessary to the Hartford Company or the Western Massachusetts Company to meet the emergency, and not for any other purpose. Our reaction, from the legal standpoint, is [3598] strongly against any other use of such connection. The exception does not seem to have any other reasonable interpretation, in view of the general purpose of the act.

Very truly yours,

CARMODY & THOMS

By W E Thoms

WET/B

EXHIBIT 57.

CARMODY & THOMS
Attorneys at Law
Lilley Building Waterbury Connecticut

Terence F Carmody
William E Thoms
William J Larkin Jr
Walter F Torrance
Maurice T Healey Jr

John D Thoms
Terence C Carmody
Edward T Carmody
Guerin B Carmody

Tax Counsel
Alfred C Frodel

Telephones
3 0107
3 0108
3 0109

May 27, 1936.

The Connecticut Light and Power Company, 36 Pearl Street, Hartford, Connecticut.

Gentlemen:

You will recall that Section 1414 (c) of the Public Acts, Supplement of 1935, in its first sentence sets forth as the purpose of the section, the preservation of the full power in the State to regulate its public service corporations, to increase the powers of the public utilities commission, and to promote local control of Connecticut public service corporations, and that this Act of 1935 shall be construed to effectuate these purposes. The question that comes up just now is whether the State Commission has the right and power to forbid any company organized under the laws of this State and doing business herein, from making such connections for the purchase or interchange of power with companies in other states as will bring such company within the jurisdiction of the Federal Power Commission under the provisions of Title II Part II of the Federal Public Utility Act of 1935.

Under sub-title (b) of Section 1414 (c) of the State 1935 Act, above cited, the State Commission has very broad powers and may order such changes in the manner of operation as may be necessary

in the public interest. It certainly is in the public interest as construed under (a) of the same section to promote and keep control of Connecticut corporations within the jurisdiction of the State of Connecticut and it clearly would seem as though the Commission had the right and power to order a cessation of an interstate exchange of power which will certainly lead to the divesting of State control and the attaching of Federal jurisdiction, if continued beyond any emergency period. Furthermore, any such exchange of power has to be by contract, express or implied, and the Commission has the power to look into the provisions of such contracts, and, if by reason of their being disadvantageous to citizens of this State, because of their subjecting the operation and rates of the whole [*3600*] system to the expense connected with Federal jurisdiction, probably it has power to disapprove such contracts and forbid the exchange of power thereunder.

Connecticut public utility corporations are chartered for the purpose of service to the people of Connecticut and not for the purpose of subjecting themselves to Federal jurisdiction and thus depriving the people of this State of their control, and we think the State, through the Public Utilities Commission, has the power to restrict the operations of such companies to service within the State. Whether or not this might be true of individuals is another question, but as to chartered public utility companies, given special privileges by the State, the right seems pretty clear.

If anything else occurs to you we will be glad to discuss it with you.

Yours truly,

CARMODY & THOMS

WET:G By W E Thoms

* * * * * * [3646]

EXHIBIT 64.

DAYS HAVING HOURS WHEN FALLS VILLAGE GENERATION WAS LESS THAN THE DELIVERIES TO CENTRAL HUDSON GAS & ELECTRIC CORPORATION AND SIMULTANEOUSLY MASSACHUSETTS ENERGY WAS RECEIVED AT SOUTH MEADOW SUBSTATION

January 11, 1937	April 18, 1937	May 26, 1937
January 16, 1937	April 19, 1937	May 28, 1937
January 17, 1937	April 20, 1937	May 30, 1937
January 18, 1937	April 21, 1937	May 31, 1937
January 22, 1937	April 22, 1937	June 1, 1937
January 23, 1937	April 23, 1937	June 13, 1937
January 24, 1937	April 24, 1937	June 14, 1937
January 25, 1937	April 25, 1937	June 20, 1937
January 26, 1937	April 26, 1937	June 21, 1937
January 27, 1937	April 27, 1937	June 23, 1937
January 28, 1937	April 28, 1937	June 24, 1937
January 30, 1937	May 1, 1937	June 25, 1937
January 31, 1937	May 2, 1937	July 3, 1937
February 20, 1937	May 3, 1937	July 4, 1937
February 22, 1937	May 5, 1937	July 5, 1937
February 23, 1937	May 6, 1937	April 10, 1938
February 24, 1937	May 8, 1937	April 11, 1938
February 25, 1937	May 9, 1937	May 16, 1938
February 26, 1937	May 10, 1937	July 3, 1938
February 27, 1937	May 15, 1937	July 24, 1938
February 28, 1937	May 19, 1937	July 25, 1938
March 7, 1937	May 20, 1937	July 30, 1938
April 8, 1937	May 21, 1937	July 31, 1938
April 10, 1937	May 22, 1937	August 1, 1938
April 15, 1937	May 24, 1937	August 2, 1938
April 17, 1937	May 25, 1937	August 3, 1938

December 9, 1938
December 10, 1938
December 11, 1938
December 13, 1938
March 27, 1939
March 28, 1939
April 2, 1939
April 3, 1939
April 16, 1939
April 20, 1939
April 21, 1939
April 22, 1939
April 23, 1939
April 24, 1939
April 25, 1939
April 26, 1939
April 27, 1939
April 28, 1939
April 29, 1930
April 30, 1939
May 1, 1939
May 2, 1939
May 3, 1939
May 4, 1939
May 6, 1939
May 7, 1939
May 8, 1939
December 19, 1939
December 20, 1939
January 7, 1940
January 11, 1940
January 12, 1940
April 11, 1940
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May 26, 1940
May 29, 1940
May 30, 1940
May 31, 1940
June 1, 1940
June 2, 1940
October 15, 1940
October 17, 1940
October 18, 1940
October 21, 1940
October 26, 1940
October 30, 1940
December 30, 1940
December 31, 1940
January 5, 1941
February 9, 1941
February 10, 1941
April 7, 1941
April 8, 1941
April 9, 1941
April 10, 1941
April 11, 1941
April 12, 1941
April 13, 1941
April 14, 1941
April 15, 1941
April 20, 1941
April 21, 1941
April 26, 1941
April 27, 1941
May 26, 1941

EXHIBIT 65.

DAYS HAVING HOURS WHEN FALLS VILLAGE GENERATION WAS ZERO AND SIMULTANEOUSLY MASSACHUSETTS ENERGY WAS RECEIVED AT SOUTH MEADOW SUBSTATION

February 3, 1937	December 14, 1937	May 5, 1938
March 5, 1937	December 15, 1937	May 6, 1938
March 20, 1937	January 3, 1938	May 9, 1938
March 21, 1937	January 9, 1938	May 10, 1938
May 11, 1937	January 10, 1938	May 13, 1938
May 12, 1937	January 11, 1938	May 14, 1938
May 13, 1937	January 20, 1938	May 15, 1938
May 16, 1937	January 26, 1938	May 17, 1938
June 1, 1937	January 27, 1938	May 24, 1938
June 7, 1937	January 28, 1938	May 25, 1938
June 14, 1937	January 29, 1938	May 30, 1938
June 15, 1937	January 31, 1938	July 18, 1938
June 29, 1937	February 1, 1938	August 22, 1938
July 11, 1937	February 2, 1938	August 23, 1938
July 12, 1937	February 9, 1938	August 25, 1938
August 2, 1937	February 19, 1938	August 27, 1938
August 5, 1937	February 25, 1938	August 29, 1938
August 10, 1937	February 28, 1938	August 30, 1938
August 19, 1937	March 1, 1938	September 6, 1938
August 24, 1937	March 4, 1938	September 7, 1938
August 25, 1937	April 4, 1938	November 7, 1938
September 4, 1937	April 5, 1938	November 13, 1938
September 27, 1937	April 6, 1938	November 19, 1938
October 11, 1937	April 27, 1938	November 25, 1938
November 11, 1937	April 28, 1938	November 26, 1938
November 22, 1937	April 29, 1938	November 28, 1938
November 24, 1937	April 30, 1938	November 30, 1938
November 27, 1937	May 2, 1938	December 2, 1938
December 12, 1937	May 3, 1938	December 27, 1938
December 13, 1937	May 4, 1938	January 1, 1939

January 3, 1939
January 4, 1939
January 5, 1939
January 10, 1939
January 14, 1939
January 15, 1939
January 16, 1939
February 6, 1939
March 10, 1939
March 11, 1939
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June 11, 1939
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July 2, 1939
October 29, 1939
October 31, 1939
November 3, 1939
November 4, 1939
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January 11, 1940
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February 23, 1940
June 15, 1940
June 16, 1940
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June 18, 1940
June 19, 1940
July 3, 1940
July 14, 1940
September 3, 1940
September 29, 1940
October 30, 1940
November 3, 1940
November 5, 1940
December 19, 1940
February 23, 1941
April 23, 1941
April 27, 1941
April 28, 1941
April 29, 1941
April 30, 1941
May 1, 1941
May 8, 1941
May 24, 1941
May 26, 1941

[3650]

EXHIBIT 66.

OFFICE MEMORANDUM.

Form 445

To R. H. Knowlton, Vice President — Date June 21, 1935

At Hartford, Connecticut

Subject

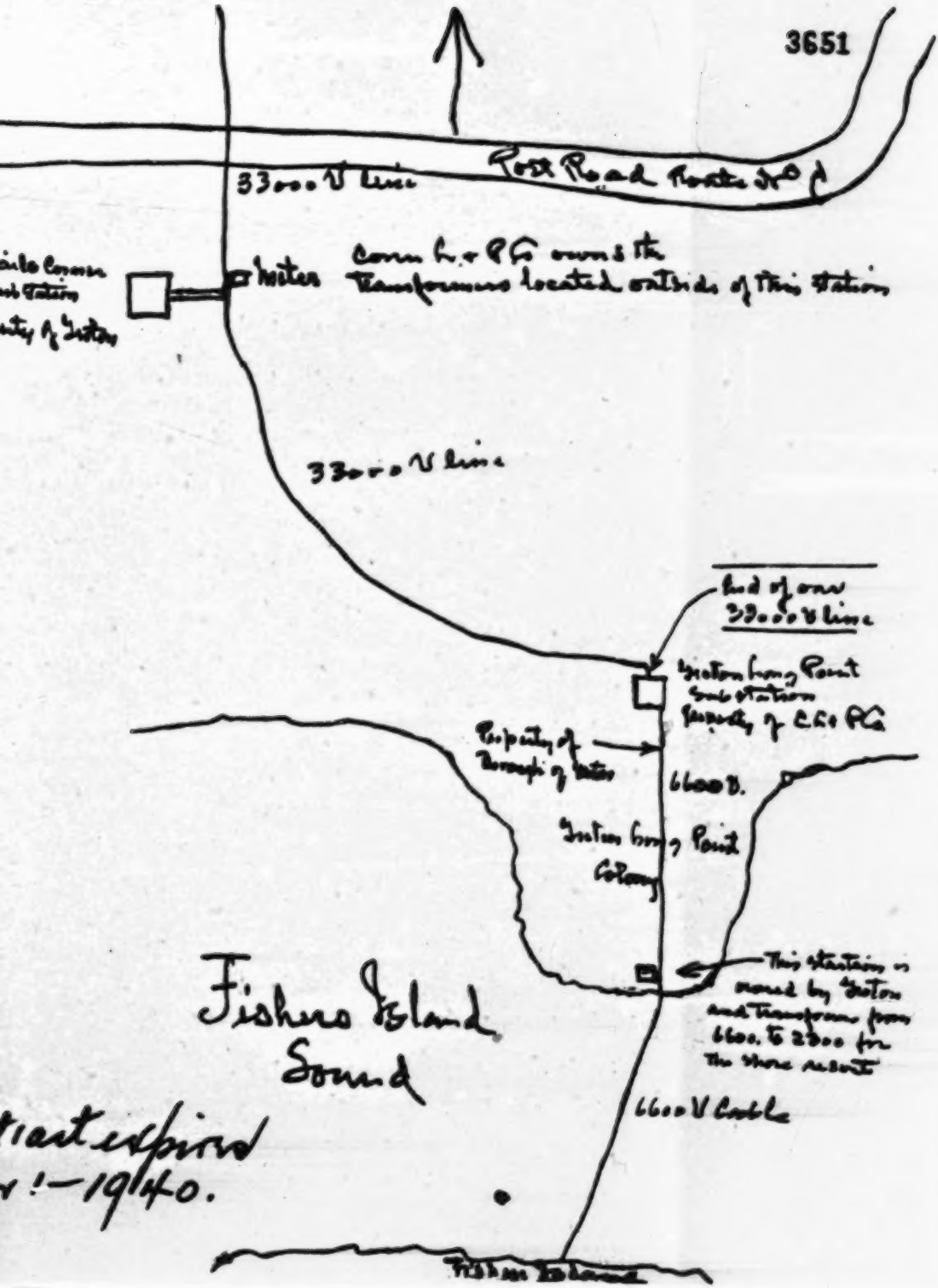
To make our deliveries to the Borough of Groton absolutely clear under the terms of the contract, I think I will have to refer you to the attached very rough sketch, and then call your attention to the wording in paragraph 3, on page 2, of our contract with the Borough, emphasizing the words "at the above mentioned substation of the Power Company at Trail's Corner in the Town of Groton; the end of its existing 33,000 volt transmission line at Groton Long Point and such other points as may be mutually agreed upon."

Our deliveries now are at two points, the substation owned by the Borough of Groton near Trail's Corner, so-called, and at the high tension side of the transformers at Groton Long Point. There is but one metering point; namely, on the line just outside of the Trail's Corner station. The transformers in this station, reducing the voltage from 33,000 to 2,300 volts, are our property while all the rest of the station is owned by the Borough. The 33,000 volt transmission line from Trail's Corner to Groton Long Point, and the Groton Long Point substation, is owned by us.

These three items, representing an investment of $30,210.00, are leased to the Borough; that is, they pay us 11 per cent on the investment and they are devoted wholly to their uses. At the Groton Long Point substation the voltage is transformed to 6600 volts, and from this point a single circuit to the extreme south end of Groton Long Point and the cable delivers the energy to Fisher's Island at 6600 volts. This line is tapped at the point of contact between the distribution system and the cable to take care of local service.

It seems to me that this takes care of us for the delivery is definitely in the contract, and in point of fact is "the end of its existing 33,000 volt transmission line at Groton Long Point."

R W PERKINS
Vice President.



tract expired
r 1 — 1940.

[3652]

EXHIBIT 67.

May 16, 1939

Mr. W. C. Allen, Division Plant Superintendent Western Union Telegraph Company 60 Hudson Street New York City

Columbia-Colchester Line

Dear Sir:–

The Connecticut Light & Power Company is constructing a 22,000 volt transmission line from its existing substation at Columbia to its existing substation at Colchester. Your facilities will be crossed at one point as shown on the photostat copy of map attached.

We are also sending you one print of our drawing No. 9065-A showing construction at the crossing, which will be in accordance with Public Utilities Docket No. 5700.

The Company is also planning to raise the voltage on the existing East Hampton-Leesville Line from 13,800 to 22,000 volts. This line crosses your facilities on the Airline branch of the railroad at two points as shown on the enclosed map. The insulation at these crossings will be equivalent to the new construction on the Columbia-Colchester line.

Will you kindly notify us, in duplicate, at your earliest convenience whether or not you have any objection to our proposed construction where your facilities are involved.

Yours very truly,

C. T. H.

C. T. HUGHES

Attachment OJZ:S General Superintendent

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* * * * * * [3665]

EXHIBIT 75.

Copy September 6th, 1935

MEMORANDUM *re* BOROUGH OF GROTON

Our contract with the Borough of Groton dated March 31st, 1930, for a period of 10 years and thereafter until cancelled by 12 months notice, contains the following provisions:

We are to deliver energy at Trail's Corner, Groton Long Point, and at such other points as may be mutually agreed upon. The delivery points are the low tension terminals of the transformers at Trail's Corner at the end of our 33 KV line at Groton Long Point and such other points as may be mutually agreed upon.

Energy is to be metered on the high tension side of the transformers at each point of delivery.

At Trail's Corner we own the land upon which the transmission line and transformers are erected, and also the lines, transformers and metering equipment.

We also own a 100 KVA feeder regulator which is inside the brick substation building at that location owned by the Borough of Groton.

At Groton Long Point substation, we own the land on which the substation is erected, together with the transformers, substation and metering equipment, but do not own anything beyond the confines of this substation lot.

The Borough of Groton pays us an 11% annual investment charge on $30,210.12 covering the transformers and substation equipment which we own at Trail's Corner and at the Groton Long Point substation, and also our investment in the second transmission circuit from the Chicken Farm to the Groton Long Point substation.

On October 31st, 1933, the Borough of Groton, through its Superintendent, requested that energy delivered to them be measured through one meter. Due to uncertainties which at that time existed in regard to the use of the transmission lines beyond Trail's Corner, it was not possible to promptly comply with this request. We did, however, make the change requested, and, beginning June 11th, 1935, we began metering their entire load at 33,000 volts at one point at the Trail's Corner substation, and have since that time billed them accordingly. Since June 11th, 1935, therefore, we have had two delivery points as before, one at the low tension terminals of the transformers at Trail's Corner, and the other at the terminals of our transmission lines at the

Groton Long Point substation, with a single metering point at 33 KV at Trail's Corner.

The transformers at the Groton Long Point substation step down from 33,000 to 6600 volts, and from the low tension side of these transformers the Borough of Groton has run a 6600 volt circuit to Groton Long Point. This circuit is for the most part overhead, but goes underground for the last 400 ft. approximately. This [3666] underground enters a small brick substation building which the Borough owns located near the shore at Groton Long Point. Just outside of this building, three 50 K V A 6600 to 2300 volt transformers supply the Borough's Groton Long Point load. A 2300 volt feeder and street lighting circuits extend a part of the distance back toward the Groton Long Point substation on the poles which also carry the 6600 volt overhead circuit. In the Borough's substation building, the Borough has made connection with submarine cables. The 6600 volt circuit, extending south from the Groton Long Point substation, therefore, supplies both the submarine cables and the Borough's Groton Long Point distribution. All of this 6600 volt and 2300 volt line and equipment belongs to the Borough of Groton.

The accompanying sketch may serve to more clearly show how this layout is arranged.

H. D. LARRABEE

Operating Superintendent.

[NOTE: The sketch map attached to Exhibit 75 and referred to therein is not printed—copies will be made available by counsel for the use of the Court.]

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* * * * * * [3668]

EXHIBIT 76.

May 29, 1940

Mr. R. H. Knowlton, Executive Vice President Hartford

Attached please find original letter from Day, Berry & Howard to Mr. Campbell, relative to the Borough of Groton matter, which Mr. Campbell asked to be returned to his office.

Mr. Larrabee and I met Mr. Tiffany and Mr. White at the Savings Bank in New London this morning and discussed the matter of a new contract, and told them of the advice that we had received from counsel. At first they felt that the contract could be so written by Mr. Day that it would cover the point which he brought up and even suggested a three-party contract. Fortunately Mr. Nathan Belcher, who is a prominent citizen of New London and a large property owner in Groton, happened to be in the bank, and since he was a lawyer and interested in matters pertaining to Groton, Mr. White asked him to come in. He introduced Mr. Belcher as Judge and stated the situation in what both Mr. Larrabee and I thought was a very satisfactory manner, and Judge Belcher was very helpful, as he advised them that it looked as if the Fishers Island load would have to be given up if they wished to renew the contract with us. Prior to this both Mr. White and Mr. Tiffany indicated a strong desire to retain the business and suggested that they could get the service from the Narragansett people or else they could buy from the Electric Boat or generate their own power. Mr. Tiffany finally admitted, however, that there was not much profit in the Fishers Island business, at which time I pointed out that a considerable amount of money could be saved by serving Groton Long Point at 2300 volts instead of a higher voltage, which would be necessary with the Fishers Island load.

The matter was left that we would submit within two weeks a proposed new contract for the supply of service to the Borough of Groton, with the understanding that if they continued to do business with us they would request the Fishers Island people to provide their own source of supply at the earliest possible moment. Judge Belcher, recommended this, stating that upon the presentation of this proposal the Borough could then consider whether they wanted to deal with the Narragansett company, make their own power or buy from the Electric Boat.

Fortunately Mr. White suggested that no publicity be given to this matter, particularly as affecting the Fishers Island load. Just

how closely Mr. Tiffany will follow this I do not know as he had mentioned earlier that he had made previous reports periodically to the Utilities Commission and the Federal Power Commission that they were supplying power to Fishers Island and that the supplying company had not "acted ugly'" about trying to get them to give it up. In the early part of the conversation he intimated that he might have to write [3669] the Federal Power Commission or take the matter up with the state Utilities Commission.

Both Mr. Larrabee and I felt that the meeting was very satisfactory and productive of good. Whether the matter will be handled as it was suggested by Mr. White and Judge Belcher I do not know.

I am preparing a proposed contract for the supply of service to the Borough for sale and use entirely within the limits of their chartered territory and will review the matter with you before presenting it.

A. V. S. LINDSLEY
Vice President

AVSL/ek Attach.

CC—Mr. H. D. Larrabee, Division Manager—Willimantic

[3670]

EXHIBIT 77.

DAY, BERRY & HOWARD
Counsellors at Law
750 Main Street

Edward M. Day
Joseph F. Berry
Lawrence A. Howard
James W. Carpenter
Allan K. Smith
Cyril Coleman
Julius G. Day, Jr.
Olcott D. Smith
Charles S. House
Austin D. Barney
Ralph C. Dixon
Richard F. Berry
Russell W. Viering
William E. C. Bulkeley

Hartford, Connecticut Trust
Company Building
Hartford, Connecticut

May 28, 1940

C. L. Campbell, President Connecticut Light & Power Co. Hartford, Connecticut

Dear Mr. Campbell:

I have been considering the matter of the contract between the Connecticut Light and Power Company and the Borough of Groton. The present contract bears the date, March 31, 1930, and was to be effective from April 1, 1930 until April 1, 1940 and thereafter until terminated by one year's notice. As I understand it, notice of cancellation was served on the Borough of Groton on September 27, 1939 and becomes effective on September 29, 1940.

We have talked, as you remember, somewhat about possible renewal of this contract. I think I ought to call your attention to the fact that the Borough of Groton was incorporated by a special act of the General Assembly of the State of Connecticut approved June 1, 1933. The territorial limits of the Borough of Groton are clearly set forth in this act, and the borough is given corporate authority to provide a water supply for its inhabitants and also to

produce, generate, and manufacture gas and electricity and to sell it to the inhabitants of the borough.

[*3671*] Borough of Groton

It is my opinion that the Borough of Groton has no authority to buy electricity from you and sell it outside of the territorial limits of the borough. And in doing so it involves the Connecticut Light & Power Company in what might possibly be considered an ultra vires act. Whatever may have happened in the past, it is my opinion that in any renewal of this contract, provision should be made to avoid any possible direct or indirect condition of this kind.

Very truly yours,

emd:vpb EDWARD M. DAY.

[*3672*]

EXHIBIT 78.

December 5, 1935.

Mr. W. Rodman Peabody, Peabody, Brown, Rowley & Storey, 201 Devonshire Street, Boston, Massachusetts.

Dear Br. Peabody:

Many thanks for yours of the 4th.

We agree with your opinion but unfortunately the Connecticut Light & Power counsel advise them that there is serious danger of all transmission lines connecting with those of the Connecticut Power Company being adjudicated as facilities under the control of the Commission—based on the unbroken package theory of the Attleboro Case and some natural gas cases. Therefore they refuse to take the risk, and urge us to remain connected to them rather than to Turners Falls.

We are therefore in the position of having, at this time, to make a permanent choice as to whom we shall play with; that is to say it is permanent so long as the Act stands if we elect to reconnect with Turners Falls because once under the Commission control we cannot change our minds and get out—but of course not permanent if we make the other election.

The logical and economic way to serve the Connecticut Valley is for the tidewater base load stations to supplement the water powers of the valley as we have been doing in the past, and therefore quite independent of our past pleasant relations, our choice in this dilemma is to reconnect.

Another difficulty with reconnection is that it makes uncertain the Connecticut Power Company exemption under Title I, and to be safe it will be necessary to merge our subsidiary companies into the Connecticut Power Company and thus become exempt under Section 3(a)(2) instead of depending on the definitions to be accorded to the words "predominately" and "substantially" in Section 3 (a) (1). This question does not arise in your case but does for the Connecticut Power Company by reason of its becoming the re-sale agent of the relatively large volume of exchange power. [3673] In view of the seriousness of the decision to us, and the known desires of the New England Power Company to cut us out, would you not consider some kind of a "favored nation" term contract between our companies to be appropriate. I don't mean anything specific as to detail but simply (other things being equal) that you will play with us in preference to New England. I know that is the intent of the present officers but personnel is liable to change in the course of ten or fifteen years.

Yours very truly,

S. FERGUSON,

Chairman of the Board.

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* * * * * * [3680]

EXHIBIT 85.

Memorandum showing number of hours in Exhibits 64 & 65 during which Falls Village generation was zero and simultaneously Massachusetts energy was received at South Meadows Substation, or when Falls Village generation was less than the deliveries to Central Hudson Gas & Electric Corporation, and simul-

taneously, Massachusetts energy was received at the South Meadows Substation on Mr. Miller's theory.

Year	No. of days listed in Ex. 64 & 65	No. of Hours fulfilling above conditions	Total No. of hours in period covered	%
1941	25	139	3,624	3.73
1940	52	251	8,784	2.74
1939	75	400	8,760	4.57
1938	72	282	8,760	3.22
1937	97	614	8,760	7.01
	321	1,676	38,688	4.33

[3681]

EXHIBIT 86.

LARGEST AMOUNT OF DEMAND DURING SINGLE MONTHS PURCHASED BY THE CONNECTICUT LIGHT AND POWER COMPANY FROM THE TORRINGTON ELECTRIC LIGHT COMPANY FOR WINSTED DISTRICT.

	1937	1938	1939	1940	1941
January	864	1,104	1,312	1,760	1,728
February	976	864	1,264	1,712	1,560
March	1,008	800	992	1,536	1,584
April	864	864	848	1,280	1,440
May	880	880	1,088	1,200	1,584
June	1,056	1,024	1,216	1,424	1,344
July	1,008	1,140	1,264	1,552	
August	1,152	1,282	1,488	1,632	
September	1,312	1,216	1,600	1,584	
October	1,376	1,376	1,776	1,608	
November	1,152	1,184	1,856	1,776	
December	1,136	1,280	1,952	1,536	

7/25/41

[3682]

EXHIBIT 87.

LARGEST AMOUNT OF DEMAND DURING SINGLE MONTHS PURCHASED BY CONNECTICUT LIGHT & POWER CO. FROM CONNECTICUT POWER CO. FOR THE EAST HAMPTON DISTRICT.

	1937	1938	1939
January	537.6	931.2	1,200
February	517.2	993.6	1,056
March	604.8	700.8	1,056
April	696	758.4	1,008
May	576	782.4	1,056
June	883.2	1,046.4	1,017.6 (Final)
July	1,027.2	1,027.2	
August	1,176	1,176	
September	1,032.8	1,084.8	
October	1,113.6	1,180.8	
November	931.2	1,324.8	
December	915.84	1,200	
7/25/41			

* * * * * * [3684]

EXHIBIT 90.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS.

UNIFORM SYSTEM OF ACCOUNTS FOR ELECTRIC UTILITIES

Prepared and submitted by the Committee on Statistics and Accounts of Public Utility Companies of the National Association of Railroad and Utilities Commissioners at its 1936 Annual Convention held in Atlantic City, N. J., November 10–13, 1936. The Convention adopted the following Resolutions:

"Whereas, The Committee on Statistics and Accounts of Public Utility Companies, after extended study and many conferences, has submitted proposed systems of accounts for gas and electric utilities; and

"Whereas, This Association believes that uniformity in utility accounting is most desirable in the public interest:

"Resolved, That the systems of accounts contained in the reports of said Committee be recommended to the Commissions represented in the membership of this Association for consideration, and for adoption in their respective jurisdictions, with such modifications only as they may deem necessary in the public interest."

[3685] 16. Transmission and Distribution Plant.

For the purpose of this system of accounts:

A. "Transmission system" means: (1) all land, conversion structures, and equipment employed at a primary source of supply (i.e., generating station, or point of receipt in the case of purchased power) to change the voltage or frequency of electric energy for the purpose of its more efficient or convenient transmission; (2) all land, structures, lines, switching and conversion stations, high tension apparatus, and their control and protective equipment between a generating or receiving point and the entrance to a distribution center or wholesale point, and (3) all lines and equipment whose primary purpose is to augment, integrate or tie together the sources of power supply.

B. "Distribution system" means all land, structures, conversion equipment, lines, line transformers, and other facilities employed between the primary source of supply (i.e., generating station, or point of receipt in the case of purchased power) and of delivery to customers, which are not includible in transmission system, as defined in paragraph A, whether or not such land, structures and facilities are operated as part of a transmission system or as part of a distribution system.

Note.—Stations which change the energy from transmission to distribution voltage shall be classified as distribution stations.

C. Where poles or towers support both transmission and distribution conductors, the poles, towers, anchors, guys, and right of way shall be classified as transmission system. The conductors, cross arms, braces, grounds, tie-wire, insulators, etc., shall be classi-

fied as transmission or distribution facilities, according to the purpose for which used.

D. Where underground conduit contains both transmission and distribution conductors, the underground conduit and right of way shall be classified as distribution system. The conductors shall be classified as transmission or distribution facilities according to the purpose for which used.

E. Land (other than right of way) and structures used jointly for transmission and distribution purposes shall be classified as transmission or distribution according to the major use thereof.

* * * * * * [3729]

BEFORE THE
FEDERAL POWER COMMISSION.
Docket No. IT-5665.

In the Matter of
CONNECTICUT LIGHT & POWER COMPANY.

PETITION FOR REHEARING AND STAY OF ORDER.

Now comes the Connecticut Light & Power Company, Respondent in the above entitled cause, and makes application by petition to the Honorable Commission for a rehearing on the Commission's Order entered on May 15, 1942, and on its Opinion No. 75, which was incorporated into and made a part of said Order, and respectfully represents that the Respondent is aggrieved by the aforementioned Order and Opinion, adopted by the Commission, containing its findings of fact and conclusions therefrom, and brings this petition under the provisions of Section 313(a) of the Federal Power Act. The Respondent is aggrieved in particular by the aforementioned order requiring it to comply with Order No. 42 mentioned therein, Order of May 11, 1937, and other orders supplemental to said Order No. 42, and to comply with the accounting requirements prescribed thereby applicable to public utilities within the meaning of that term as used in [3730] the Act as of the effective dates of such Orders, and to file within ninety days from the date of said Order of May 15, 1942, the data and information required by Electric Plant Accounts Instruction 2-D of the Uniform System of Accounts, and the aforesaid Order of May 11, 1937.

[Here follow those extracts from the petition for rehearing which are printed on pages 7–27 of this Appendix, together with certain matter which is omitted therefrom. These pages are numbered 3730–3750, inclusive, in the record filed in this Court.]

* * * * * * [3751]

The Respondent also specifies in this petition various rulings made in the course of the proceedings by the Trial Examiner, which rulings appear to have been adopted by the Commission. In support of this application, it relies upon the following errors of this kind, and contends that the Commission erred in so far as it approved, adopted or failed to reverse the following rulings of the Trial Examiner, to all of which exceptions were duly taken (as appears by the general arrangement appearing at pp. 44–45, 227 and 490 of the official stenographer's report of the proceedings).

[Here follow those extracts from the petition for rehearing which are printed on pages 28–33 of this Appendix.]

* * * * * * [3764]

The Respondent hereby makes application that the rehearing herein asked for be held at some date after the conclusion of the present war in which the United States of America is engaged and that said Order entered on May 15, 1942, be stayed pending decision after rehearing and for a reasonable time thereafter, and as reasons for said application the Respondent says:

(1) That the Order of May 15, 1942, is premised upon Opinion No. 75 of the Commission, which opinion raises questions of general importance and widespread application, and that such matters should be considered by the Commission upon the application for rehearing:

(2) That the Public Utilities Commission of the State of Connecticut has ordered a reclassification of accounts for electric and gas utilities, which reclassification requires the particular utility to show the cost to it and the original cost of its electric or gas utility plants, and such reclassification results in a system of accounts similar to the classification of accounts of the Federal Power Commission;

(3) That in order to comply with the reclassification of accounts provided for by the Public Utilities Commission of Con-

necticut, Respondent requested the independent engineering firm of Day & Zimmerman, Inc., of Philadelphia, Pennsylvania, to make a survey and estimate of the personnel and cost necessary to reclassify the plant accounts of Respondent on an original cost basis. The report of Day & Zimmermann, Inc. recommends that Respondent, in [3765] order to reclassify its accounts, employ, or provide from its personnel, a special group of accountants, engineers, clerks and typists (approximately 70 persons) for a period of eighteen months, at a cost of $350,000.00.

(4) That in view of the war emergency, to undertake such studies at the present time is not possible because of lack of sufficient personnel, or the possibility of obtaining from outside sources such personnel; that even if it were practicable to obtain seventy persons to do the work at the present time, that could be done only by taking people away from work more directly concerned with the war, and that it seemed better, therefore, to postpone this job until after the war is over, when there may be some unemployment and this job would help to furnish employment to people who otherwise might not be able to obtain employment.

(5) That on February 2, 1942, the Public Utilities Commission of the State of Connecticut granted Respondent's request that the undertaking of its reclassification of accounts be deferred in the following language:

> "In view of the war emergency and the possibility that the energy and attention of the officers and employees of the company may be needed for war purposes more acutely than in compliance with the orders of the Commission as to accounting, the Commission is unwilling to assume the responsibility in this case of substituting its judgment for that of the management to the degree of insisting upon immediate compliance. The request of the company is therefore granted for a period of one year."

[3766] (6) On February 2, 1943, when the present extension of time to undertake this job will have expired, if conditions re-

main substantially as they are at present, the Respondent expects that it will be necessary for it to apply to the Public Utilities Commission of Connecticut for a further extension of time until the end of the war, and it believes that the Public Utilities Commission, recognizing the conditions, will grant such an extension.

(7) The Respondent is an electric utility company whose personnel and plant are now largely devoted to the maintenance of an abundant supply of electric energy necessary for the successful prosecution of the war in which the United States is now engaged. The Respondent serves 65% of the territory of the State of Connecticut, and 41% of the state's population. A recent survey made by the Respondent indicates that it is serving 280 customers who are directly engaged in war production work, and that for the year 1942, 45% of the Respondent's entire sales of electricity, amounting to 408,000,000 kilowatt hours, or a kilowatt load of more than 57,000 kilowatts, will be to companies engaged directly in war production work. The personnel of the Respondent is also actively engaged, at the order of the War Production Board, in an effort to coordinate its facilities with those of other companies, both utility and industrial, in New England, to the end that an adequate and proper supply of electricity may be available for all of the industries in New England engaged in the war effort. As set forth above, a large portion of the [3767] Respondent's total sales of electric energy, including sales to other utilities, is devoted to war production. In addition, Respondent is also engaged in supplying gas and water services in certain communities throughout Connecticut to persons and industries engaged in war work. Also, the demand upon Respondent to supply electric energy for essential services, such as hospitals, pumping stations, sewage disposal plants, state armories, state highway departments, schools, police stations, etc.—services intimately connected with public health and safety—has been materially increased. Not only has the Respondent been subject to load increase demands because of war conditions, but also the requirements of war production have placed upon its personnel

heavy demands. The character of the work done by the Respondent at the present time is indicated by the high priorities granted the Respondent in connection with new facilities which it is in the process of installing to take care of capacity deficiencies occasioned by the war load. Such increases in the load on Respondent's system result from the large number of load increases from industries hitherto converted to war production, and it is estimated that new manufacturing facilities devoted entirely to war production will increase in the future, resulting in still further demands upon the Respondent.

(8) That enforced compliance with the Commission's Order of May 15, 1942, pending the determination of the application for rehearing, or within a reasonable period thereafter, would cause undue and unnecessary hardship on the Respondent.

[3768] That Respondent has not been furnished a copy of the Trial Examiner's report made upon the hearing held in the above entitled cause.

WHEREFORE on the grounds hereinbefore set forth the Respondent respectfully prays:

(a) That this Honorable Commission grant a rehearing in these proceedings to be held after the conclusion of the present war in which the United States of America is engaged;

(b) That upon such rehearing, this Honorable Commission make each of the findings and rulings herein requested;

(c) That upon such rehearing, this Honorable Commission adopt an order vacating, setting aside, and annulling the Order of the Commission entered on May 15, 1942, and its Opinion No. 75, which was incorporated into and made a part of said Order herein complained of;

(d) That pending the disposition of this petition, all further proceedings in this cause be stayed and suspended;

(e) That said Order be stayed until decision after rehearing and for a reasonable time thereafter, or for such other time as may be proper and reasonable under all the circumstances;

(f) That a copy of the Trial Examiner's report in the above entitled cause be furnished to or access thereto granted the Respondent.

[*3769*] (g) That this Honorable Commission grant such other and further relief as may be appropriate in the premises.

THE CONNECTICUT LIGHT AND POWER COMPANY, [CORP.]
By ROBERT H. KNOWLTON, [SEAL]
Executive Vice-President,
36 Pearl Street, Hartford, Connecticut.

CLAUDE BRANCH of
CHOATE, HALL & STEWART,
30 State Street, Boston, Massachusetts,
and
LAWRENCE A. HOWARD, and
OLCOTT D. SMITH of
DAY, BERRY & HOWARD,
750 Main Street, Hartford Connecticut,
Attorneys for Petitioner.

STATE OF CONNECTICUT,
COUNTY OF HARTFORD.

The undersigned, being first duly sworn, states that he is Executive-Vice President of The Connecticut Light and Power Company, the Petitioner in the foregoing petition; that he has read the petition and knows the contents thereof; that all of the statements contained therein are true and correct to the best of his knowledge and belief.

ROBERT H. KNOWLTON
Executive Vice-President.

Subscribed and sworn to before me, a Notary Public in and for said County and State, this 12th day of June, 1942.

MARY M. WALSH,
Notary Public.
[NOTARIAL SEAL]

[*3770*] CERTIFICATE OF SERVICE

I hereby certify that service of the foregoing Petition was made upon Howard E. Wahrenbrock, Counsel for the Federal Power Commission, on June 13th, 1942, by delivering a copy thereof to Leon M. Fuquay, Secretary of the Federal Power Commission, addressed to the said Howard E. Wahrenbrock.

s/ JOHN L. CURRY.

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37	Letter from Carmody & Thoms to The Connecticut Light and Power Company dated May 27, 1936	1133, 1134
64	Days having hours when Falls Village generation was less than the deliveries to Central Hudson Gas & Electric Corporation, etc.	1135, 1136
65	Days having hours when Falls Village generation was zero and simultaneously Massachusetts Energy was received at South Meadow substation	1137, 1138
66	Office Memorandum and Sketch	1139–1141
67	Letter from C. T. Hughes, General Superintendent to Mr. W. C. Allen, Division Plant Superintendent, Western Union Telegraph Company dated May 16, 1939	1143
75	Memorandum *re* Borough of Groton dated September 6th, 1935	1143–1145
76	Letter from A. V. S. Lindsley, Vice President, to Mr. R. H. Knowlton, Executive Vice President, dated May 29, 1940	1145–1147
77	Letter from Edward M. Day to C. L. Campbell, President, Connecticut Light & Power Co. dated May 28, 1940	1148, 1149
78	Letter from S. Ferguson, Chairman of the Board, to Mr. W. Rodman Peabody dated December 5, 1935	1149, 1150
85	Memorandum showing number of hours in Exhibits 64 and 65, etc.	1150, 1151
86	Memo—Largest Amount of Demand, etc.	1151
87	Memo—Largest Amount of Demand, etc.	1152
90	Uniform System of Accounts for Electric Utilities	1152–1154

[fol. 1169] Wednesday, December 8th, A. D., 1944

Before Honorable Justin Miller, Associate Justice, Honorable Armistead M. Dobie, Circuit Judge, sitting by designation, and Honorable Thurman Arnold, Associate Justice.

Proclamation being made the Court is opened.

No. 8341

THE CONNECTICUT LIGHT & POWER COMPANY, Petitioner,

vs.

FEDERAL POWER COMMISSION, Respondent

Argument commenced by Mr. Claude R. Branch, attorney for petitioner, continued by Mr. Howard E. Wahrenbrock, attorney for respondent, and concluded by Mr. Claude R. Branch, attorney for petitioner.

[fol. 1170] [Stamp:] United States Court of Appeals for the District of Columbia. Filed Feb. 28, 1944. Joseph W. Stewart, Clerk.

UNITED STATES COURT OF APPEALS, DISTRICT OF COLUMBIA

No. 8341

THE CONNECTICUT LIGHT & POWER COMPANY, Petitioner,

vs.

FEDERAL POWER COMMISSION, Respondent

Petition for Review of Order of the Federal Power Commission

Argued December 8, 1943 Decided February 28, 1944

Mr. Claude R. Branch, for petitioner. *Mr. John L. Hall* also entered an appearance for petitioner.

Mr. Howard E. Wahrenbrock, Assistant General Counsel, with whom *Messrs. Charles V. Shannon*, General Counsel,

and *Louis W. McKernan*, Principal Attorney, all of the Federal Power Commission, were on the brief, for respondent.

Before Miller, Dobie,* and Arnold, JJ.

ARNOLD, *Associate Justice:*

The Federal Power Commission after extensive hearings found that the petitioner, The Connecticut Light and Power Company, was a public utility within the meaning of the Federal Power Act, and ordered it to comply with the uniform system of accounts prescribed by the Commission under Section 301 of the Act. The case is before us for a review of the finding and order of the Commission. Since it is conceded that the petitioner must comply with the order if it is a public utility under the Act, the sole question before us is whether the finding of the Commission to that effect is sustained by substantial evidence and by a correct interpretation of the law.[1]

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* Sitting by assignment of the Chief Justice of the United States, pursuant to the provisions of the Act of December 29, 1942, entitled "An Act to amend the Judicial Code to authorize the Chief Justice of the United States to assign circuit judges to temporary duty in circuits other than their own."

[1] Statutes Involved.

Federal Power Act, 49 Stat. 847, U. S. C. Title 16, § 824(a).

Part II—Regulation of Electric Utility Companies Engaged in Interstate Commerce.

Declaration of Policy; Application of Part; Definitions.

Section 201. (a) It is hereby declared that the business of transmitting and selling electric energy for ultimate distribution to the public is affected with a public interest, and that Federal regulation of matters relating to generation to the extent provided in this Part and the Part next following and of that part of such business which consists of the transmission of electric energy in interstate commerce and the sale of such energy at wholesale in interstate commerce is necessary in the public interest, such Federal regulation, however, to extend only to those matters which are not subject to regulation by the States.

[fol. 1171] The Connecticut Light and Power Company distributes electricity to a substantial part of the State of Connecticut, including 107 towns, cities and boroughs with a total population of 660,000, and about 130,000 additional consumers served by other Connecticut utilities which purchase electric current from the petitioner. On the Saturday before the Monday on which the Act took effect petitioner

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(b) The provisions of this Part shall apply to the transmission of electric energy in interstate commerce and to the sale of electric energy at wholesale in interstate commerce, but shall not apply to any other sale of electric energy or deprive a State or State commission of its lawful authority now exercised over the exportation of hydroelectric energy which is transmitted across a State line. The Commission shall have jurisdiction over all facilities for such transmission or sale of electric energy, but shall not have jurisdiction, except as specifically provided in this Part and the Part next following, over facilities used for the generation of electric energy or over facilities used in local distribution or only for the transmission of electric energy in intrastate commerce, or over facilities for the transmission of electric energy consumed wholly by the transmitter.

(c) For the purpose of this Part, electric energy shall be held to be transmitted in interstate commerce if transmitted from a State and consumed at any point outside thereof; but only insofar as such transmission takes place within the United States.

(d) The term "sale of electric energy at wholesale" when used in this Part means a sale of electric energy to any person for resale.

(e) The term "public utility" when used in this Part or in the Part next following means any person who owns or operates facilities subject to the jurisdiction of the Commission under this Part.

* * * * * * *

Federal Power Act, 49 Stat. 854, U. S. C. Title 16, § 825 (a)

Part III—Licenses and Public Utilities; Procedural and Administrative Provisions.

[fol. 1172] was unquestionably engaged in the interstate transmission of electric energy as defined by the Act. It was a member of the Connecticut Valley Power Exchange for the interchange of electric energy between companies in Massachusetts, Connecticut and New York. Its facilities were designed so that this interchange of energy created substantial savings and constituted the most efficient use of the system. In a last minute effort to avoid Federal jurisdiction the petitioner severed its main interstate connection in spite of the fact that this added to the cost of furnishing electricity to consumers in Connecticut. It was, however, unable to sever all its interstate connections and it is on these remaining connections that the government rests its case.

Accounts, Records, and Memoranda.

Section 301. (a) Every licensee and public utility shall make, keep, and preserve for such periods, such accounts, records of cost-accounting procedures, correspondence, memoranda, papers, books, and other records as the Commission may by rules and regulations prescribe as necessary or appropriate for purposes of the administration of this Act, including accounts, records, and memoranda of the generation, transmission, distribution, delivery, or sale of electric energy, the furnishing of services or facilities in connection therewith, and receipts and expenditures with respect to any of the foregoing: *Provided, however*, That nothing in this Act shall relieve any public utility from keeping any accounts, memoranda, or records which such public utility may be required to keep by or under authority of the laws of any State. The Commission may prescribe a system of accounts to be kept by licensees and public utilities and may classify such licensees and public utilities and prescribe a system of accounts for each class. The Commission, after notice and opportunity for hearing, may determine by order the accounts in which particular outlays and receipts shall be entered, charged, or credited. The burden of proof to justify every accounting entry questioned by the Commission shall be on the person making, authorizing, or requiring such entry, and the Commission may suspend a charge or credit pending submission of satisfactory proof in support thereof.

The principal connections which remained after the passage of the Act were (1) with an interstate line from Massachusetts owned by the Connecticut Power Company (a separate organization) which is tapped by the petitioner; and (2) with facilities which transmitted electric energy to Fishers Island in New York until 1941. We will consider the effect of these interstate connections separately.

The Power Line from Massachusetts Tapped by the Petitioner.

The Connecticut Power Company in the operation of the Connecticut Valley Power Exchange supplies energy from various plants in Massachusetts to an interstate power line which is tapped in Connecticut by petitioner to supply East Hampton, Torrington-Winsted and Bristol. While there are sources of supply within the state for these communities, meter readings taken by the government show that a substantial amount of current reaches these communities from this interstate power line. We need not consider seriously the contention of the petitioner that scientifically conclusive proof of interstate transmission of energy is impossible because, as testified by petitioner's experts, "with all the information it is ever going to be possible for us to obtain, nobody is ever going to answer the question in a unique way as to which load the power from a particular station goes to". A distinction between electric current as measured on a meter and electric energy was certainly not within the contemplation of Congress when it passed the Act: indeed, no scientist knows what the nature of electric energy is. Ordinary meter readings which measure electric current are sufficient data on which to make charges for electricity to users. That they are equally sufficient to determine the interstate transmission of energy under the Federal Power Act is shown by the case of *Jersey Central Company* v. *Federal Power Commission*, 319 U. S. 61 (1943).

A more serious question which petitioner raises is whether the ownership of facilities in Connecticut for tapping an interstate line in order to supply power to local communities is sufficient to make it a public utility. Petitioner contends that such facilities are not within the jurisdiction of the Commission because they are used in local distribution. Petitioner's argument runs as follows: It is not required to keep accounts unless it is a "public utility". [Section

301] A public utility is any person who owns or operates facilities subject to the *jurisdiction* of the Commission [Section 201(e)]. The Commission does not have *jurisdiction*, except as specifically provided, over facilities used in local distribution. [Section 201(b)] While the Act specifically provides for the keeping of accounts on facilities in [fol. 1173] local distribution it does not specifically provide for *jurisdiction* over such local facilities. [Section 301] From this it is argued that even though the energy which petitioner distributes comes from another state it is not a public utility under the jurisdiction of the Commission because the facilities which it owns are for local distribution.

Such a construction is a grammatical possibility. However, it contradicts the broad purpose of the Act to correct abuses of write-ups, inflation of accounts and similar practices which have on occasion been found in the utility industry. It would permit a company which operated facilities that were normally designed for the interstate transmission of electric power to split itself into segments, one of which owned the power line and the other the distribution system. By such artificial corporate manipulation the Federal Power Commission would get jurisdiction over the tail of what was in fact an interstate set-up (to wit: the high voltage line), and lose jurisdiction over the dog (the main distribution system). It would encourage the setting up of unnecessarily complicated accounting systems between the owners of the segments of the artificially divided power system, which the Act is designed to eliminate. The Federal Power Act obviously intends to confer Federal jurisdiction upon electric distribution systems which normally would operate as interstate businesses. It is not an act to put a premium on artificial corporate reorganization. It is not surprising, therefore, that the construction urged by the petitioner has been expressly overruled in the case of *Hartford Electric Light Co.* v. *Federal Power Commission*, 131 F. (2d) 953 (C. C. A. 2nd, 1942), cert. den. 319 U. S. 741 (1943). The opinion of Judge Frank in that case analyzes the provisions of the Act so well that we need not repeat it here. He reaches what seems to us the proper conclusion that Section 201(b) means to give the Commission jurisdiction over any facility for the transmission of electric energy in interstate commerce. The "but" clause in the section is intended to make it clear that this jurisdiction extends even to local facilities where the Act provides for

their regulation, as it does in the case of accounting practices.

Therefore, whether or not the facilities by which petitioner distributes energy from Massachusetts should be classified as "local" is not relevant to this case. The sole test of jurisdiction of the Commission over accounts is whether these facilities, "local" or otherwise, are used for the transmission of electric energy from a point in one state to a point in another.[3] Since actual meter readings in this case show such an interstate flow of current to supply petitioner's facilities it is a public utility under the Act.

The only alternative to such a conclusion is to adopt the argument of the petitioner that a point can be selected in the [fol. 1174] instantaneous transmission of energy from Massachusetts to Connecticut where interstate transmission ends and intrastate transmission begins. Petitioner suggests that point can be found at the station where it taps the admittedly interstate line. This theory assumes that electricity is carried in little buckets. The owner of the interstate line carries the bucket on its interstate journey and hands it to the petitioner in Connecticut. And thus the transmission of electricity is made to look like the sale of a pair of shoes. This conception contradicts all we know about electrical transmission. It is the kind of mythological offspring of a union between the law and the natural sciences that makes scientists (except expert witnesses) tear their hair. It is true that such myths cannot be avoided as the vehicle of judicial discussion in many cases,—for example where the issue is the limits of taxing power between Federal and State governments. But those are cases where it is apparent that Congress intended the courts to use

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[3] There is a superficial inconsistency between the above statement and the concluding phrase in Section 201(a) "* * *" such Federal regulation, however, to extend only to those matters which are not subject to regulation by the States". This limitation, however, has been held by the Supreme Court of the United States not to apply to the sections of the Act which specifically give the Federal Power Commission jurisdiction over matters of financial arrangement, such as the accounting section which we are discussing here. *Jersey Central Co. v. Federal Power Com.*, 319 U. S. 61.

such artificial conceptions. We believe it was to escape this legal-electric mythology that the Federal Power Act made the test of jurisdiction depend, not on the current definition of "interstate commerce" but on the actual transmission of electric energy from one state to another without regard to the mechanical means of that transmission. This language gives us no excuse for indulging in the bucket theory of electrical transmission or for differentiating between the different kinds of equipment over which the energy flows in its instantaneous passage from a generator in one state to a consumer in another. It makes the test of whether such energy is actually transmitted between the two states the simple and practical one of reading a meter.

The adoption of this test, based on the underlying purpose of the Act, compels us to give serious consideration to petitioner's argument that it is being used here to defeat the purpose of the Act by giving the Commission jurisdiction over a system that is essentially intrastate because of some trivial or temporary connection from the outside. We do not believe Congress intended that a large electric power system which was essentially intrastate in character should come under Federal jurisdiction because of some insignificant or temporary outside connection. But if we keep the purpose of the Act in mind we can avoid unreasonable extensions of Federal jurisdiction. The court needs only to look at the character of the organization and its facilities in order to determine whether it can reasonably be classified as an interstate system. Intelligent interpretation of the Act does not bind us to a rule of thumb.

In the case before us the history of petitioner's operations removes all doubt as to its essentially interstate character. At the time the Act was passed petitioner's transmission system was so clearly interstate in character that it could operate most economically only by taking advantage of the savings afforded by an interstate electrical pool. The severing of connections, both contractual and otherwise, with that pool was not done as a normal business operation but as a last minute attempt to escape Federal jurisdiction. In order to accomplish that severance petitioner was compelled to load on to consumers unnecessary additional expense in furnishing electricity. The record contains evidence which establishes the improvident business character of converting the system to a relatively intrastate opera-

[fol. 1175] tion.[8] The attempt to make petitioner's operations appear intrastate was an artificial and costly gesture against sound business policy and against the interests of Connecticut consumers. And even after this gesture had been made there still remained some interstate connections which apparently could not be severed. The evidence that the use of petitioner's facilities on a purely intrastate basis was not a normal nor an efficient nor an economical use of that system supports the finding that it is in fact a system designed for interstate transmission of electricity. In severing its connections to avoid Federal jurisdiction petitioner restricted the availability of low cost electricity in Connecticut and raised a serious question whether such a restraint of interstate commerce for such a purpose was legal. But whether legal or not, it was an abnormal use of the transmission system, a use that would have amounted to bad business management except for the desire to escape Federal jurisdiction. These considerations are sufficient to convince us that the Commission in this case is not attempting to control a normally intrastate business through the accident of a trivial outside connection.

Transmission of Energy to Fishers Island, New York.

The second connection with interstate transmission relied on by the government to support Federal jurisdiction is the fact that from the time of the passage of the Act until February, 1941, petitioner was supplying electric current to Fishers Island in New York. The current was sold to the Borough of Groton and resold by that municipality to Fishers Island. Petitioner stopped supplying the Borough with

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[8] "In the event that you wish to separate our systems, the matter can perfectly well wait until the time of the December peak has passed.

"Our reason for the above decision is that we believe that the chance of our position being overruled by the courts is too remote to justify the loss of $100,000 a year and the greater plant investment to be shortly required under the present operating condition."

(Excerpt from letter of S. Ferguson, Chairman of the Board of Directors, Connecticut Power Company, to J. Henry Roraback, President, Connecticut Light & Power Company, dated November 19, 1935.)

electricity for resale on the pretended ground that such resale was an ultra vires act. The actual reason was to escape Federal jurisdiction. Petitioner cannot escape Federal jurisdiction on the ground that the interstate movement of electric current to Fishers Island did not begin until the energy left the facilities of the petitioner at Groton. The current transmitted to Fishers Island amounted to only .2% of petitioner's business, but this fact would be significant only in a case where the Commission was attempting to get jurisdiction over a normally intrastate business because of some temporary and negligible outside sales. As we have shown, this is not such a case.

The finding of the Commission that the petitioner is a public utility is amply supported by the evidence. Its order will, therefore, be

Affirmed.

[fol. 1176] [Stamp:] United States Court of Appeals for the District of Columbia. Filed Feb. 28, 1944. Joseph W. Stewart, Clerk

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA, JANUARY TERM, 1944

No. 8341

THE CONNECTICUT LIGHT AND POWER COMPANY, Petitioner,

vs.

FEDERAL POWER COMMISSION, Respondent

Petition for Review of Order of the Federal Power Commission

JUDGMENT AND DECREE

This cause came on to be heard on the transcript of the record from the Federal Power Commission, and was argued by counsel.

On consideration whereof, It is now here adjudged and decreed by this Court that the order of the said Federal Power Commission on review in this cause be, and the same is hereby, affirmed.

Per Mr. Justice Arnold.

Dated February 28, 1944.

[fol. 1177] [Stamp:] United States Court of Appeals for the District of Columbia. Filed Mar. 13, 1944. Joseph W. Stewart, Clerk

IN THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA

No. 8341

THE CONNECTICUT LIGHT AND POWER COMPANY, Petitioner,

vs.

FEDERAL POWER COMMISSION, Respondent

PETITION FOR REHEARING

The Connecticut Light and Power Company, Petitioner, respectfully petitions this Honorable Court, under the provisions of its General Rules 26 and 31, to grant to it a rehearing of the above-entitled cause and as reasons for its petition shows:

1. This cause came before this Court on petition for review of an order of the Federal Power Commission (hereinafter called "the Commission") dated May 15, 1942. The order required the Petitioner to comply with certain orders and accounting requirements prescribed by the Commission applicable to "public utilities" within the meaning of that term as used in Section 201 of the Federal Power Act.[1] The ultimate questions in the hearing before the Commission and upon the petition for review in this court were whether the Petitioner is or at any time since August [fol. 1178] 26, 1935 has been such a "public utility". The Petitioner contended before the Commission and in this Court that it is not and at no such time had been such a "public utility". The Commission based its conclusion that the Petitioner was such a public utility upon its holding that the Petitioner at all times since August 26, 1935, had owned facilities subject to its jurisdiction under Part II of the Act, finding that it owned "facilities for transmission of electric energy in interstate commerce" and that certain

[1] Act of August 26, 1935, c. 687 (49 Stat. 847, U. S. C., Title 16, § 824). This section of the Act is copied in the Appendix, pp. 10-20, *infra*.

of these facilities were not "facilities used in local distribution" within the meaning of Section 201(b)[2] of the Act.

2. Each of the parties filed a brief in this Court and the Petitioner also filed a reply brief. Oral arguments were held on December 8, 1943, before Mr. Justice Miller, Mr. Justice Arnold, and Judge Dobie. On February 28, 1944, the Court handed down its opinion affirming the order of the Federal Power Commission.

3. The Petitioner in this Court challenged certain findings of fact of the Commission bearing upon the jurisdiction of the Commission and contended that the Act must be construed as requiring this Court to weigh the evidence and make its own determination of jurisdictional facts, and in the alternative contended that if the statute were construed as requiring this Court merely to ascertain whether there was substantial evidence to support such findings it would be unconstitutional, for reasons set forth in its brief and [fol. 1179] mentioned hereafter.

The opinion of the Court stated:

> "* * * Since it is conceded that the petitioner must comply with the order if it is a public utility under the Act, the sole question before us is whether the finding of the Commission to that effect is sustained by substantial evidence and by a correct interpretation of the law."

It is apparent from the opinion that the Court did not consider that it was under the duty of weighing the evidence and making its own determination of the jurisdictional facts upon the evidence. The opinion contains no discussion of the following contentions made in our original brief (pp. 28-29):

> "* * * this Court is under the duty of weighing the evidence and making its own determination thereon. If the statute were construed to require this Court merely to ascertain whether there was some substantial evidence to support the findings, it would be unconstitutional (1) in that it would deprive Petitioner of

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[2] Act of August 26, 1935, c. 687 (49 Stat. 847, U. S. C., Title 16, § 824(b)).

property without due process of law in violation of the provisions of Article V of the Amendments to the Constitution of the United States; (2) that it would curtail the powers of the Judiciary in violation of the provisions of Article III, Sec. 2 of the Constitution; and (3) that it would confer on the United States a power reserved to the State of Connecticut in violation of the provisions of Article X of the Amendments. *Crowell* v. *Benson*, 285 U. S. 22; *St. Joseph's Stock Yards Co.* v. *United States*, 298 U. S. 38, 51; *Baltimore & Ohio Rd. Co.* v. *United States*, 298 U. S. 349, 364; *Bradley Lumber Co.* v. *National Labor Relations Board*, 84 F. 2d 97, 100 (C. C. A. 5th), cert. den. 299 U. S. 559; *National Labor Relations Board* v. *Cherry Cotton Mills*, 98 F. 2d 444, 446 (C. C. A. 5th). See also *United States* v. *Appalachian Electric Power Co.*, 107 F. 2d 769, 791 (C. C. A. 4th), reversed 311 U. S. 377 (see pp. 403, 404, 429); *Ohio Valley Water Co.* v. *Ben Avon Borough*, 253 U. S. 287; *Gudmundson* v. *Cardillo*, 126 F. 2d 521, 524, 75 App. D. C. 230.

[fol. 1180] "In this connection it should be borne in mind that it is expressly stipulated in Section 313(b) of the Federal Power Act, which provides for review by this Court, that upon the filing of the transcript herein, 'such court shall have exclusive jurisdiction to affirm, modify or set aside such other, in whole or in part', and that the statute contains no other provision for challenging the order of the Commisison or any finding of fact upon which it is based.[3]

"The statute should not be construed in such a way as to raise grave doubt as to its constitutionality. *Crowell* v. *Benson*, 285 U. S. 22, 62, and cases there cited."

We respectfully submit that these contentions should be considered upon a rehearing.

4. The opinion of the Court in effect sustains the finding of fact by the Commission that a substantial amount of electric energy from outside of Connecticut reached the facili-

[3] Act of August 26, 1935, c. 687 (49 Stat. 860), U. S. C. Title 16, §825 *l*(b).

ties of the Petitioner at East Hampton, Torrington-Winsted and Bristol. In its discussion of this matter the opinion of the Court says:

> "* * * We need not consider seriously the contention of the petitioner that scientifically conclusive proof of interstate transmission of energy is impossible because, as testified by petitioner's experts, 'with all the information it is ever going to be possible for us to obtain, nobody is ever going to answer the question in a unique way as to which load the power from a particular station goes to.' A distinction between electric current as measured on a meter and electric energy was certainly not within the contemplation of [fol. 1181] Congress when it passed the Act; indeed, no scientist knows what the nature of electric energy is. Ordinary meter readings which measure electric current are sufficient data on which to make charges for electricity to users. That they are equally sufficient to determine the interstate transmission of energy under the Federal Power Act is shown by the case of *Jersey Central Company* v. *Federal Power Commission*, 319 U. S. 61 (1943),"

This seems to us to indicate that the Court misunderstood our contention in regard to the matter.

The facts were that the facilities of the Petitioner in quesion were at all times connected with generating plants in Connecticut which contemporaneously generated more than the combined loads of these three areas of the Petitioner. (App.[4] 949-953) As the engineer of the Commission admitted, there were no meters which showed the source of the energy which reached the facilities of the Petitioner.[5] The

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[4] "App." refers to the Appendix to Brief of Petitioner, containing extracts from the evidence, etc.

[5] The following are extracts from the testimony of the Commission's engineer, Thomas (App. 601-603):

"Q. Now, I think that you testified in effect that there were instruments for determining the flow of energy and he rate of flow that you designated as watt-meters or watthour meters; is that correct? A. I remember stating that.

generating plants in Connecticut were nearer these loads [fol. 1182] of the Petitioner than were the generating plants in Massachusetts. (See App. 1113) In these circumstances we contend there was no established principle by which energy reaching the facilities of the Petitioner could be identified as coming from Massachusetts.

We did not suggest that there was any "distinction between electric current as measured on a meter and electric energy * * * within the contemplation of Congress when it passed the Act."

As the Court evidently misunderstood our contentions, we submit that the matter should be clarified on rehearing.

5. The opinion of the Court concludes that the ownership of facilities "used in local distribution" is sufficient to

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"Q. Such meters, of course, do not show the source of the energy, do they? A. Well, the meter itself doesn't have a marking on it to show where it came from. In Mr. Miller's case, the meter doesn't show red and blue or anything of that sort.

"Q. And of course there is not at Bristal or Winsted or any of the East Hampton District any instrument which shows the source of the energy that was received there at any time? A. No, not that you can determine from the reading on the instrument.

"Q. And as a matter of fact it is impossible by examining or by any other observation that you can make of energy at a particular point, to know where it is generated? A. I think that is correct.

* * * * * * *

"Q. Let me ask you a specific question. Let us assume that there is energy put on the CP line No. 1 from Falls Village, and there is also energy put on that line from Hartford. There is no physical observation or no reading of any meter on that line that would enable you to determine at any particular point what proportion of the energy came from one source and what from the other? A. Well, the instruments that are put on the line are only intended to read the total. So, of course——

"Q. And the — A. So, of course, they wouldn't indicate parts. They are not intended for that purpose."

submit the Petitioner to the jurisdiction of the Commission as a "public utility" within the meaning of the Act if the facilities are also facilities "for transmission of electric [fol. 1183] energy in interstate commerce." In doing this, it construes the clause which it designates as the "but" clause in Section 201(b) of the Act not as an exception to the preceding part of the sentence in which it occurs (as we contended it should be), but as "intended to make it clear that this jurisdiction extends even to local facilities where the Act provides for their regulation." It is noteworthy that the opinion of the Commission did *not* so construe this clause.

The opinion of the Court concedes that the construction for which we contended is a "grammatical possibility," and states that "there is a superficial inconsistency" between the construction which the Court adopts and the concluding phrase of Section 201(a).

The sentence in Section 201(b)[6] in which the clause in question occurs is as follows:

> "* * * The Commission shall have jurisdiction over all facilities for such transmission or sale of electric energy, but shall not have jurisdiction, except as specifically provided in this Part and the Part next following, over facilities used for the generation of electric energy or over facilities used in local distribution or only for the transmission of electric energy in intrastate commerce, or over facilities for the transmission of electric energy consumed wholly by the transmitter."

The exceptions "specifically provided in this Part and the Part next following" appear to relate only to facilities for generation—which are referred to in various provisions of these Parts. But "facilities used in local dis- [fol. 1184] tribution" are nowhere else specifically referred to—unless perhaps in Section 303,[7] which applies only to agencies of the United States. Conceivably the exception

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[6] Act of August 26, 1935, c. 687 (49 Stat. 847), 16 U. S. C. § 824(b).

[7] Act of August 26, 1935, c. 687 (49 Stat. 855), 16 U. S. C. 825b.

clause under discussion is intended to indicate that if a company is a public utility or if a company's aid is needed in an emergency its distribution facilities as well as its other facilities may be subject to the Commission's orders, but even if this is one purpose of the clause, we submit that it was also its purpose to exempt "facilities used in local distribution" as a basis for the general jurisdiction of the Commission.

The reasoning of the opinion of this Court in support of its conclusion appears to be based upon "the broad purpose of the Act," but we submit that the legislative history of the Act shows clearly that the purpose of the Act was not to give the Commission jurisdiction over a company owning only facilities used in local distribution.

The legislative history of the Act is set forth in some detail in *Jersey Central Power & L. Co.* v. *Federal Power Commission*, 129 F. 2d 183, 193, 194, and the dissenting opinion in *Jersey Central Co.* v. *Federal Power Commission*, 319 U. S. 61, 85-87, to which for convenience we hereby refer. The outstanding significant facts in respect of the clause under discussion are that Congress clearly did not intend to extend Federal jurisdiction to all facilities connected "as parts of a system of power transmission situated in more than one state" (as proposed in the bill originally introduced in the Senate),[8] that continual efforts were [fol. 1185] made to narrow the basis of jurisdiction originally proposed, and that the ultimate intention was to exclude "facilities used in local distribution" from the categories of facilities subjecting a company to the general jurisdiction of the Commission.

The provision for jurisdiction over facilities in Section 201(a) of the Bill as reported to the Senate by the Senate Committee (designated S. 2796) and as the Bill passed the Senate was as follows:

> "The Commission shall have jurisdiction over all facilities for such production, transmission, or sale of electric energy by any means and over all facilities connected therewith as parts of a system of power transmission situated in more than one State, except facilities used only for the production or transmission of electric energy in intrastate commerce or in local dis-

[8] S. 1725, 74th Cong. 1st Sess., February 6, 1935.

tribution or for the use of the producer or transmitter."[9]

This, it is clear, specifically excepted from the jurisdiction of the Commission "facilities used in local distribution."

The House Committee on Interstate and Foreign Commerce rewrote certain provisions of the Bill and reported it to the House (S. 2796 with amendments, Report No. 1318, House of Representatives, 74th Congress, 1st Session). As so reported, the clause applying to "facilities used in local distribution" was the same as in the Act finally passed, except that it did not contain the words "except as specifically provided in this Part and the Part next following." The House enacted the clause as reported.

It is clear that the House did not intend to confer juris- [fol. 1186] diction of the Commission over a company because of ownership of facilities used in local distribution. The Report of the House Committee contained the following language (p. 27):

> "As in the Senate bill no jurisdiction is given over local distribution of electric energy, and the authority of States to fix local rates is not disturbed even in those cases where the energy is brought in from another State."

Throughout the discussion on the floor of the House there appear abundant manifestations of Congressional purpose to preserve to the States the powers which they then had. See 79 Cong. Rec. Part 9, pp. 10357, 10377, 10378, 10384-10387, and Part 10, 10574.

Owing to the differences between the bills passed by the two Houses, the matter was referred to conferees.

They inserted the phrase "except as specifically provided in this Part and the Part next following." This is the first time this phrase appears, and the Report of the House conferees accompanying the Conference Report (74th Congress, 1st Session, House Report No. 1903, p. 74) asserted that it is merely "a clarifying phrase added to remove any doubt as to the Commission's jurisdiction over facilities used for the generation and local distribution of electric energy to

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[9] *Jersey Central Power & L. Co.* v. *Federal Power Commission*, 129 F. 2d 183, 193.

the extent provided in *other* sections of this part and the part next following." (Emphasis ours.) In the light of this statement and the fact that there was no dispute between the House and the Senate as to the provision regarding local distribution, it is clear that this clause was not intended to enlarge the basis of general jurisdiction of the Commission as previously limited.

[fol. 1187] For purposes of determining the general jurisdiction of the Commission the Part next following, i. e., Part III, must be disregarded, inasmuch as Section 201(e) [10] provides:

> "The term 'public utility' when used in this Part or in the Part next following means any person who owns or operates facilities subject to the jurisdiction of the Commission under *this* Part." (Emphasis ours.)

Facilities for local distribution are nowhere specifically mentioned in other sections of "this Part", i. e., Part II, and if they are included to any extent, it is only for temporary purposes. Section 202(d) [11] provides that persons not otherwise subject to the jurisdiction of the Commission "shall not become subject to the jurisdiction of the Commission by reason of such temporary connection or temporary construction." Thus it is clear that the jurisdiction of the Commission is not to attach solely because of facilities used in local distribution.

The matter is definitely and clearly summarized in the following extract from the opinion in *Jersey Central Power & L. Co.* v. *Federal Power Commission*, 129 F. 2d 183, 194:

> "As we have said Section 201(a) of the Act states explicitly that the federal regulation proposed by the Act is intended 'to extend only to those matters which are not subject to regulation by the States', and that Section 201(b) says with equal clarity that the Commission 'shall not have jurisdiction * * * over facilities used for the generation of electric energy or over facilities used in local distribution or only for the transmission of electric energy in intrastate commerce, * * *.'

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[10] 49 Stat. 847, c. 687, 16 U. S. C. §824(e).

[11] 49 Stat. 847, c. 687, 16 U. S. C. §824a(d).

[fol. 1188] Generation of electricity, its local distribution or its transmission in intrastate commerce are not within the purview of the Act or the jurisdiction of the Commission."

This Court also appears to have been moved to adopt its construction of the "but" clause by its feeling that any other construction "would permit a company which operated facilities which were normally designed for interstate transmission of electric power to split itself into segments, one of which owned the power line and the other the distribution system." No such splitting up of companies is involved here or is possible here. The Petitioner owns no interstate power line and no power line connected with an interstate power line. Its fundamental business is generating power in Connecticut and distributing it to customers in Connecticut. If (contrary to our contentions) some energy from Massachusetts did come to the facilities of the Petitioner under discussion, that was a matter which was not subject to the control of the Petitioner and constituted but a trivial incident in the business of the Company.

Moreover, if such a construction of the Act would encourage the splitting up of a company into segments some of which would not be subject to the jurisdiction of the Federal Power Commission, that would not appear to be a reason for rejecting such a construction. The broad purpose of the Act, we submit, was to submit to Federal jurisdiction only facilities which are not subject to State jurisdiction.

[fol. 1189] Part II of the Federal Power Act, on its face, attempts to limit the sphere of federal authority delegated thereby and to preserve certain matters for State jurisdiction. Thus, in Section 201(a), Congress asserted federal regulation of certain phases of the electric utility business to be "necessary in the public interest, such Federal regulation, however, to extend only to those matters which are not subject to regulation by the States." Section 201(a).

The reports of both the Senate Committee and the House Committee on the bill contained the following statement in regard to Section 201(a):

> "Subsection (a) contains a declaration of the necessity for federal regulation and *defines the scope of that regulation* • • •" (Italics ours). Senate Report

621, 74th Congress, 1st Session, p. 48. House Report 1318, 74th Congress, 1st Session, p. 26.

Even the report of the Senate Committee on Interstate Commerce which accompanied the Bill (S 2796) in the form in which it was presented to the Senate (with the broad language quoted above) stated that it "would impose Federal regulation only over those matters which cannot be effectively controlled by the States." (Senate Report No. 621, page 18, 74th Congress, 1st Session).

And on the floor Senator Wheeler, who was in charge of the Bill, said (Congressional Record, Vol. 79, Part 8, p. 8399):

> "Utility operations, except where they extend beyond state lines, are of course matters of local or state concern; * * *".

Clearly, a company which is engaged in local distribution would be subject to State regulation, and if the other company owning the interstate line was subject to Federal jurisdiction, the purposes of the Act would be fulfilled. [fol. 1190] The opinion of the Court states that the construction for which we contend "would encourage the setting up of unnecessarily complicated accounting systems between the owners of the segments of the artificially divided power system, which the Act is designed to eliminate". We believe that this statement must have come from a misunderstanding of the situation. The facilities of the Petitioner under discussion at Bristol, for instance, were once owned by an independent company. If they were transferred back to an independent company, the result would simply be that the Bristol company would keep merely the accounts required by State law and not those required by the Federal Power Commission. Under the construction adopted by this Court, however, all of the accounts of the entire system of the Petitioner covering 107 cities, towns and boroughs must be kept in the manner required by the State law and another set of accounts for this entire system must be kept as provided by the Federal Power Commission.

Moreover, we are unable to perceive how such a splitting of a company into segments (or into two separate companies), such as the opinion suggests, would lead to "unnecessarily complicated accounting systems between the

owners of the segments". Presumably if there were such a splitting, one company would sell energy to the other, but that would lead to no complications. Such sales could be made under the simple procedure which now prevails in the numerous cases in Connecticut in which one company sells energy to another. Examples of this are the sales of the Connecticut Power Company to the Petitioner which are involved in this case.

On the other hand, the construction adopted by the Court will actually place a tremendous burden on many companies, [fol. 1191] for it will require them to keep two sets of accounts for their entire systems if anywhere for their local distribution they receive some energy generated outside of the State which they serve.

6. The holding of the Court that the facilities of the Petitioner under discussion are facilities "for the transmission of electric energy in interstate commerce" appears to us to adopt a theory of interstate commerce essentially different from that which has been adopted by the Supreme Court.

The fact that the journey of electric energy from generator to consumer is virtually instantaneous does not determine the question whether energy is in interstate or intrastate commerce at any given point in that journey. As the Court said in *Southern Pacific Company* v. *Gallaher*, 306 U. S. 167, 177:

> "'Practical continuity' does not always make an act a part of interstate commerce."

And the Courts have had no difficulty in dividing the journey of electric energy for jurisdictional purposes. See *Utah Power & Light Co.* v. *Pfost*, 286 U. S. 165, 179; *South Carolina Power Co.* v. *South Carolina Tax Commission*, 52 F. 2d. 515, 524-525.

We submit that the situation here is like that discussed in *Missouri* v. *Kansas Gas Co.*, 265 U. S. 298, 308-309, and in such cases as *Lone Star Gas Co.* v. *Texas*, 304 U. S. 224; *South Carolina Power Co.* v. *South Carolina Tax Commission*, 52 F. 2d 515 (E. D. S. C. 1931), aff'd 286 U. S. 525; 60 F. 2d 528, aff'd *sub nomine Broad River Power Co.* v. *Query*, 288 U. S. 178; *Banker Brothers Co.* v. *Pennsylvania*, 222 U. S. 210. See also *Southern Gas Corp.* v. *Alabama*, 301 U. S. 148, 154-155.

[fol. 1192] The opinion of this Court states that "it [its construction of the phrase 'transmission of electric energy in interstate commerce' "] makes the test of whether such energy is actually transmitted between the two states the simple and practical one of reading a meter", but here again we believe that the Court has misunderstood the evidence. Under such a test there has been no interstate commerce on the Petitioner's facilities, for no simple and practical reading of a meter discloses it. There was, and could be, no meter of which a simple and practical reading would show that energy came to Petitioner's facilities from Massachusetts. (See testimony of Thomas, quoted above, and App. 872). It may well be that the test as to whether such energy is actually transmitted between the two States is the simple and practical one of reading a meter, and it is possible in many cases, such as the transmission from Massachusetts to the Connecticut Power Company, so to determine that there is such transmission.

7. The opinion concludes that the Petitioner's operations have "an essentially interstate character" and evidently relies upon this conclusion in applying the provisions of the Act to it. We believe that in coming to this conclusion the Court may have confused the facilities of the Petitioner with those of other companies, including an entirely independent company with a similar name, the Connecticut Power Company.

[fol. 1193] The Connecticut Power Company owns the long transmission line which extends from the Massachusetts boundary south and west through Hartford and various Connecticut cities and towns almost to the westerly boundary of Connecticut. The Petitioner never owned any such line (or any transmission line running to the State boundary); and as has been pointed out, its business is generation of electric energy in Connecticut and distribution of electric energy in Connecticut.

Only 3 out of the 107 cities, towns and boroughs which it has served with electric energy were connected with this line of the Connecticut Power Company, and the contracts for the supply of these 3 did not call for energy generated in Massachusetts. The line was connected with generating plants in Hartford and other places in Connecticut. The contracts contained no express provision as to the source of the energy, but there was a provision that the unit charge

for energy supplied should be adjusted on the basis of the cost of coal, in the bunkers of the South Meadow plant of the Hartford Electric Light Company in Hartford, and the Hartford Electric Light Company contracted to supply the Connecticut Power Company with such capacity as might be required, in addition to the capacity of the Connecticut Power Company's own water power plants in Connecticut, to carry the loads on the C. P. 1 and 2 lines, including those in the three areas of the Petitioner under discussion. (Ex. 8, App. 1039; Ex. 25, App. 1055; Ex. 30, App. 1063; Exs. 36 and 37, App. 1081; App. 941-944, 961, 964-966).

As the opinion seems to rely heavily in various places on what it denominates as the "essentially interstate character [fol. 1194] of Petitioner's business", we submit that this matter should be clarified on rehearing.

8. The opinion of the Court contains no discussion of the contention made in part C of the brief of the Petitioner, which was headed as follows:

> "PETITIONER WAS DENIED A FAIR TRIAL (1) BECAUSE OF THE REFUSAL OF THE COMMISSION TO CONSIDER EVIDENCE OFFERED BEARING UPON THE MEANING OF THE WORDS 'USED IN LOCAL DISTRIBUTION' AS APPLIED TO FACILITIES OF PETITIONER, AND (2) BECAUSE OF THE RECEPTION OF A MASS OF INCOMPETENT EVIDENCE OVER PETITIONER'S OBJECTIONS."

We understand that under the construction of the Act adopted by the Court, the meaning of the words "used in local distribution" as applied to facilities of the Petitioner is unimportant. Nevertheless, even if this be eliminated from consideration, we submit that the reception of a mass of incompetent evidence relating to other matters entitles the Petitioner to a new trial before the Commission, and that this Court should grant a rehearing to consider this contention.

Wherefore the Petitioner respectfully requests that this Honorable Court grant it a rehearing.

By its attorneys, Claude R. Branch, 30 State Street, Boston, Massachusetts; Lawrence A. Howard, 750 Main Street, Hartford, Connecticut.

[fol. 1195] APPENDIX

Statutes Involved

Federal Power Act

Act of August 21, 1935, C. 687, Title II (49 Stat. 838)

Part II—Regulation of Electric Utility Companies Engaged in Interstate Commerce

Declaration of Policy; Application of Part; Definitions

Section 201. (a) It is hereby declared that the business of transmitting and selling electric energy for ultimate distribution to the public is affected with a public interest, and that Federal regulation of matters relating to generation to the extent provided in this Part and the Part next following and of that part of such business which consists of the transmission of electric energy in interstate commerce and the sale of such energy at wholesale in interstate commerce is necessary in the public interest, such Federal regulation, however, to extend only to those matters which are not subject to regulation by the States.

(b)[1] The provisions of this Part shall apply to the transmission of electric energy in interstate commerce and to the sale of electric energy at wholesale in interstate commerce, but shall not apply to any other sale of electric energy or deprive a State or State commission of its lawful authority now exercised over the exportation of hydro-electric energy which is transmitted across a State line. The Commission shall have jurisdiction over all facilities for such transmission or sale of electric energy, but shall not have jurisdiction, except as specifically provided in this Part [fol. 1196] and the Part next following, over facilities used for the generation of electric energy or over facilities used in local distribution or only for the transmission of electric energy in intrastate commerce, or over facilities for the transmission of electric energy consumed wholly by the transmitter.

(c)[2] For the purpose of this Part, electric energy shall be held to be transmitted in interstate commerce if trans-

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[1] 49 Stat. 847, U. S. C. Title 16, § 824(b).

[2] 49 Stat. 848, U. S. C. Title 16, § 824(c).

mitted from a State and consumed at any point outside thereof; but only insofar as such transmission takes place within the United States.

(d)[3] The term "sale of electric energy at wholesale" when used in this Part means a sale of electric energy to any person for resale.

(e)[4] The term "public utility" when used in this Part or in the Part next following means any person who owns or operates facilities subject to the jurisdiction of the Commission under this Part.

(f)[5] No provision in this Part shall apply to, or be deemed to include, the United States, a State or any political subdivision of a State, or any agency, authority, or instrumentality of any one or more of the foregoing, or any corporation which is wholly owned, directly or indirectly, by any one or more of the foregoing, or any officer, agent, or employee of any of the foregoing acting as such in the course of his official duty, unless such provision makes specific reference thereto.

[fol. 1197] CERTIFICATE OF SERVICE

Service accepted March 13, 1944.
Charles V. Shannon, General Counsel, Federal Power Commission.

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[3] 49 Stat. 848, U. S. C. Title 16, § 824(d).
[4] 49 Stat. 848, U. S. C. Title 16, § 824(e).
[5] 49 Stat. 848, U. S. C. Title 16, § 824(f).

[fol. 1198] [Stamp:] United States Court of Appeals for the District of Columbia. Filed Mar. 25, 1944. Joseph W. Stewart, Clerk.

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA, JANUARY TERM, 1944

No. 8341

THE CONNECTICUT LIGHT & POWER COMPANY, Petitioner,

vs.

FEDERAL POWER COMMISSION, Respondent

Before Miller, and Arnold and Dobie, JJ.

ORDER

On consideration of petitioner's petition for rehearing filed in this cause, It is

Ordered by the Court that the petition be, and it is hereby, denied.

Per Curiam.

Dated March 25, 1944.

[fol. 1199] [Stamp:] United States Court of Appeals for the District of Columbia. Filed Apr. 15, 1944. Joseph W. Stewart, Clerk.

IN THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA

No. 8341

THE CONNECTICUT LIGHT AND POWER COMPANY, Petitioner,

v.

FEDERAL POWER COMMISSION, Respondent

DESIGNATION OF RECORD

The Clerk will please prepare a certified transcript of record for use on petition to the Supreme Court of the

United States for writ of certiorari in the above-entitled cause, and include therein the following:

1. Appendix to appellant's brief.
2. Minute entry of argument.
3. Opinion.
4. Judgment.
5. Petition for rehearing with Clerk's memorandum of filing of petition for rehearing.

* * * * * * *

7. Order entered denying petition for rehearing.
8. This designation.
9. Clerk's certificate.

Claude R. Branch, Attorney for Petitioner.

Service accepted April 15, 1944.
Charles V. Shannon, General Counsel, Federal Power Commission.

[fol. 1200] UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA

I, Joseph W. Stewart, Clerk of the United States Court of Appeals for the District of Columbia, hereby certify that the foregoing pages numbered from 1 to 1199, both inclusive, constitute a true copy of the appendix to the petitioner's brief and the proceedings of the said Court of Appeals as designated by counsel for petitioner in the case of: The Connecticut Light and Power Company, Petitioner, vs. Federal Power Commission, Respondent, No. 8341, April Term, 1944, as the same remain upon the files and records of said Court of Appeals.

In testimony whereof, I hereunto subscribe my name and affix the seal of said Court of Appeals, at the City of Washington, this twentieth day of April, A. D., 1944.

Joseph W. Stewart, Clerk of the United States Court of Appeals for the District of Columbia. (Seal.)

[fol. 1201] SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed October 9, 1944

The petition herein for a writ of certiorari to the United States Court of Appeals for the District of Columbia is granted.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.